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FOREWORD

Highlights of most of the studies, or phases of studies, that were substantially completed during the second half of 1954 are presented in this document—the main body of ORO's semiannual report. Several other studies, dealing largely with nuclear warfare, are reported upon separately.

A footnote to each section of this report gives one of two references—either the number of the ORO publication in which further details are to be found or, in cases where the work has not reached publication stage, the study number.

Ellis A. Johnson, Director
Operations Research Office

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A Quick Survey

A RIFLE COMPANY UNDER ATOMIC ATTACK

Photographic record of a troop test discloses each member's exposure to atomic effects in the various situations common during combat. Among the recommendations: Protect command personnel—who were found to be especially vulnerable—and provide equipment that will enable a company to dig itself in fast. Page 1

ARTILLERY vs MORTARS vs TAC AIR

To achieve the same level of casualties against an area target, the F–84F costs from 2 to 20 times as much as division and corps artillery. The Army should develop a heavy mortar significantly better than the present 105–mm and should reevalute the need for the 240–mm howitzer. Page 7

THE LETHAL AREAS OF AIR-BURST SHELLS

Sample finding: For a 105–mm howitzer shell used against personnel some of whom are standing, some crouching, and some prone, the best height of burst is 12 feet. But a burst at any height between 10 and 21 feet will be at least 90 per cent efficient against each of these target types.

FOR PSYWAR AGAINST CZECHOSLOVAKIA

An area manual presents information on the history, culture, politics, and other factors necessary to an understanding of the Czechs and the Slovaks and then uses it to lay down principles of a psywar campaign. Czech and Slovak soldiers, for instance, traditionally desert a foreign military organization that they don't like and then join up with one that they do—but Czechs could never be expected to surrender to a German-speaking unit. Page 40

BEST DENSITY FOR PSYWAR LEAFLETS

Present methods of delivering leaflets in psychological warfare operations normally drop from 20 to 1000 per 1000 square meters. Analysis based on tests with friendly forces in Korea indicates that 60 is enough to ensure a high probability of man-leaflet contact. Page 42

PSYWAR'S EFFECT ON SURRENDER IN MALAYA

Propaganda was one of several factors that worked together in bringing about the surrender of Communist terrorists. Three other important ones were inadequate treatment by Communist forces, intolerable physical conditions while in combat, and a relatively great amount of combat. Page 43

SHORT REPORTS: Testing Officers' Atomic Knowledge

A test given to some 1650 officers shows a good deal of misinformation about atomic weapons and tactics. The average score on 75 questions was 43—one point higher than the score of ORO's professional employees. . . . Also *in this section* War-Gaming a Small-Unit Action . . . New Computational Methods for Symbolic Logic . . . Field Testing the Single-Call-Sign Procedure . . . Meeting the Need for Linguists . . . The Effect of Storms on Operations in Korea. Page 44

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The Rifle Company's

1

Fig. 1.—Members o... identified by letter a... on helmets—were pho... every half hour to get ... their activities and the ... of exposure to...

Vulnerability to Atomic Effects

A troop test in which every member was continually observed for seven days provides information on how vulnerability varies with the unit's action and the individual's job assignment. It leads to recommendations for increasing the chance that a company will remain effective under nuclear attack.

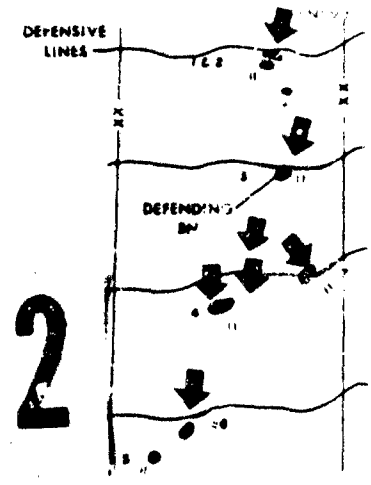


Fig. 2.—This map shows the field test situations.

HOW vulnerable are infantry troops to atomic weapons? What — if any — changes in tactics and doctrine would reduce this vulnerability yet maintain a high degree of combat effectiveness?

As the result of a troop test* to learn some of the facts of life about an infantry company's activities, answers to these questions now have a practical basis.

The test — known as VULCO and conducted at Fort Benning in February 1954 — involved a rifle company, part of a hypothetical regiment whose mission was to delay the enemy in successive positions while the division prepared a strong MLR. For seven days, over an area of 30 square miles, the company met a series of situations that included essentially all the maneuvers in which infantry troops are involved during combat — attack, defense, delaying action, and so on. Figure 3 shows the course of the action.

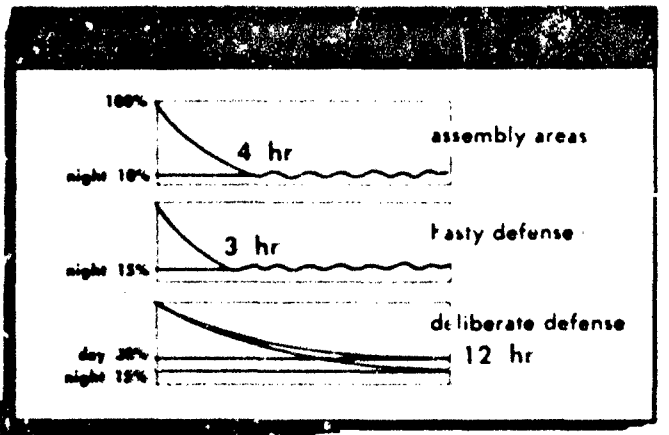
* CORG TR-1

The unit was told that atomic weapons had been used by both sides, and personnel were ordered to stay in foxholes at all times except when the situation required them to be outside.

Throughout the maneuver a team of some 60 Army and civilian observers made a photographic record of what the members of the company were doing and how much they were exposed. Each man was photographed approximately every half hour.

The photographs were analyzed as the data transferred to punch cards for sorting, printing, and summarizing. In the end the investigators knew how (a) the type of action in which the company was engaged determined the degree of exposure to atomic effects, and (b) this exposure varied according to a person's particular job assignment.

The charts show the time needed to prepare these positions and the proportion of the company exposed at various times.



Spends 1½ hr with

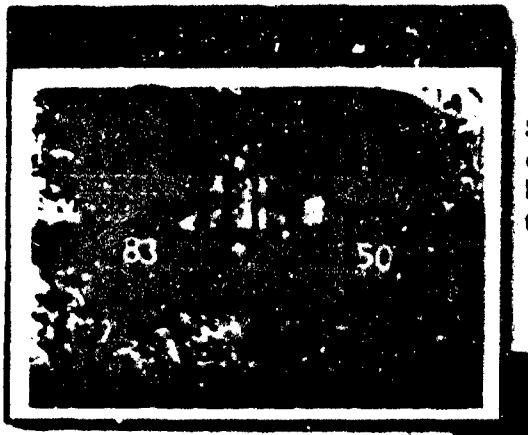
95% of its personnel in the open

Jobs at the top of this list are the most vulnerable to atomic effects, jobs at the bottom, least. Unit leaders were in open up to four times as often as other personnel.

most vulnerable

Admin & Command in Co Hq
Mess Personnel
Communications Personnel
Weapons Platoon Hq
Mortar Sections
57-mm RR Sections
Rifle Platoon Hq
Rifle Squads
Weapons Squads

least vulnerable



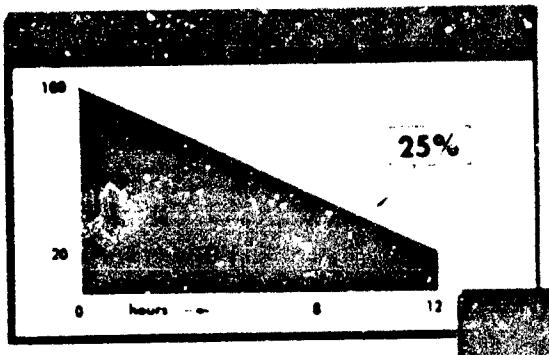
Shade offered by trees gives high degree of protection from fireball's heat. This is somewhat offset by tree blowdown and fire.

Once a man's body is just below ground level, the addition of overhead cover—up to a layer of logs and earth—affords more protection than offered by greater depth.

The foxholes it prescribes with heavy overhead cover provide a good deal of protection—

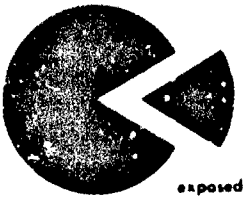
but positions take too long to prepare.

FINDINGS FROM THE VULCO STUDY (cont'd) . . .



Reduction of preparation time by one-third will reduce the percentage of men exposed in the open by one-quarter.

When occupying an assembly area or a position in light contact with the enemy, a company can carry out necessary functions with 80-90 percent of the unit always under cover.



15 to 20%

exposed during light contact

More hand tools for preparing positions

Better entrenching tool

Power saw and pneumatic drills

Explosive charges for digging holes

Mechanical hole digger

More transportation for infantry equipment

Canvas overhead cover-shelter halves while digging positions

A light overhead cover for all positions

All men fully clothed all the time

Trucks covered when transporting personnel

Field clothing redesigned to help protect areas of skin now exposed

More emphasis on protecting unit leaders

A deputy company commander

Better communications, down to rifleman level

How Digging In Pays Off

The investigators also studied the effects of atomic weapons – up to 550-KT – on personnel having various degrees of cover, and then determined what would have happened to the company under four hypothetical attacks. For example, with the company asleep at night in two-man prone foxholes, a 40-KT missile exploded at a distance of 1250 yards would have taken all but 8 percent of its members and 14 percent of its firepower. But a similar attack when the unit was well dug-in—having followed present doctrine and used presently available equipment would have left it with about 75 percent of its strength both in firepower and personnel.

What's main findings are presented on the preceding three pages.

Notice that as the company starts to prepare a position, 100 percent of its personnel are in the open—exposed to the effects of any nuclear warhead exploded close enough. The proportion falls steadily until in the case of night occupancy of a deliberate defense position it reaches 15 percent. *It needs to fall much more rapidly.* Personnel must understand that speed may mean survival. They must also take advantage of existing equipment. For example, troops can increase their protection from thermal radiation—which probably would cause the majority of atomic casualties—by digging foxholes under the cover of shelter halves. **But additional digging aids should be provided,** plus items such as gloves and masks to protect exposed skin.

Notice, too, that the most exposed individuals are the key personnel in the chain of command. Implications: (a) a company's command post should be protected; (b) a deputy commander should be appointed and, where possible, stay under cover when the commander is exposed; (c) following an attack, the senior surviving member should be able—through an improved communications system—to reach all other survivors quickly.

Another noteworthy point: Some 120 officers completed a questionnaire calling for information about the exposure of troops in the same situations as the field test and the time to complete various types of defenses. They gave the answers on the basis of their combat experience. *The resulting data agreed very closely with that obtained from the field test.*

IN SUM: To strike the best possible balance between protection and effectiveness in atomic warfare, a rifle company should speed the preparation of positions and should give more attention to shielding personnel and equipment. The changes suggested on page 4 would substantially improve the amount of protection available, and the Army should consider making them. Efforts toward greater protection than indicated here would reduce unit effectiveness.

Comparing Artillery, Mortars, and TAC Air

Against area targets of the sizes considered, the Army's own weapons are found to be far more economical than air strikes by F–84Fs. The best mortar studied is the Russian 120–mm.

IF FIELD artillery, heavy mortars, and tactical air were all available for a job that any one of them could do, which would be the most economical weapon, and by how much?

An ORO cost-effectiveness study* works with the following elements:

Weapons—the artillery, mortars, and fighter-bomber listed in Fig. 4, plus the 280 mm gun. (Note that the 120 mm mortar is a Soviet weapon.)

Targets—(a) two moderate-size personnel targets; (b) a small personnel target representing an emplaced mortar or machine gun crew; (c) two small hard targets representing a field artillery piece or any other target that can be defeated by one hit by a 2.75-inch rocket or larger weapon; (d) a soft vehicle target—2½ ton truck. The targets are close enough to the MLR to be within range of each weapon.

Costs—among the costs taken into account are those of procurement, personnel, transportation to a front in Central France, and operation of the weapons system.

Activity levels—in the case of artillery and mortars, they are based on day-of-supply rates given in the field manuals. Each aircraft is assumed to fly 20 sorties per month.

Weapon accuracy—for military, firing table errors are multiplied by 2 for low-angle fire and by 3 for high-angle fire; for mortars, the military characteristic specifications of 1 percent of range and 3 mils deflection are doubled; for the F-84F, bombing and rocketry errors are based on combat and test data.

Casualty probabilities—these are calculated on the basis of the size and vulnerability of the target, the fragmentation characteristics of the shell or bomb, and the accuracy with which it is delivered.

For each weapon, the study first determines the cost of delivering one round or bomb to the target and then the number of rounds required to produce a given level of casualties or damage. Only conventional ammunition is used and morale effects are not considered.

*ORO [illegible] Number 11

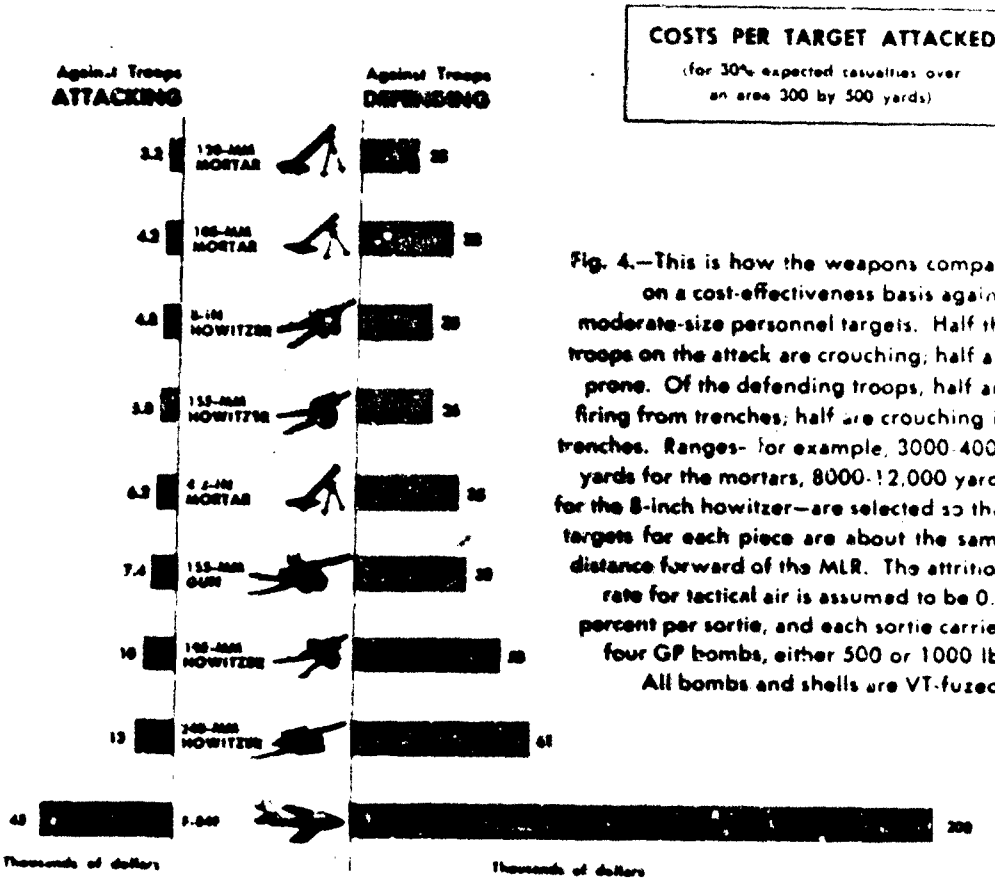


Fig. 4.—This is how the weapons compare on a cost-effectiveness basis against moderate-size personnel targets. Half the troops on the attack are crouching; half are prone. Of the defending troops, half are firing from trenches; half are crouching in trenches. Ranges—for example, 3000-4000 yards for the mortars, 8000-12,000 yards for the 8-inch howitzer—are selected so that targets for each piece are about the same distance forward of the MLR. The attrition rate for tactical air is assumed to be 0.3 percent per sortie, and each sortie carries four GP bombs, either 500 or 1000 lb. All bombs and shells are VT-fuzed.

The Findings

Against area targets. Figure 4 shows how the weapons compare against a representative personnel target. Notice that the F-4E in this case is anywhere from 3 to 15 times more expensive than the other weapons, with the exception of the 280-mm gun, not shown. (In another case it is up to 20 times as expensive.) Among the artillery weapons, the 8-inch howitzer is the best, with the 155-mm howitzer a close second. All the mortars are better than the 105-mm howitzer. The Russian weapon,

the 120 mm mortar, is the best heavy mortar studied, and somewhat better—though not significantly—than the 155 mm howitzer.

Against small personnel targets, artillery again is much cheaper than tactical air. The 120 mm is again the most economical mortar, but the 155 mm and 8-inch howitzers are the best weapons.

Against small, hard targets, such as artillery pieces, there is no clear-cut choice between the artillery using *observed* fire and aircraft carrying the 2.75-inch rocket. At the longer ranges and against the smaller target the airplane looks best.

Against stationary vehicles, the fighter bomber is from 2 to 100 times as expensive as artillery (depending on the artillery weapon used).

The weight of ammunition required for any given job is greater for tactical air than division and corps artillery (240 mm howitzer excepted). It is lower for mortars than for divisional artillery.

VT-fuzed shells are considerably cheaper than PD in counterbattery fire when the target is the crew. For knocking out the piece itself, tactical air with rockets is the best choice.

Among the Recommendations

1. Do not request air against personnel targets when artillery or mortars are available.

2. Remove the 240 mm howitzer from the present artillery family unless there is need for its atomic potential.

3. Develop a heavy mortar significantly better than the present 105 (note that the Russian 120 mm mortar is approximately twice as cheap against area personnel targets as the 4.2-inch mortar, while the 105 mm has only a marginal advantage over the 4.2 inch).

Lethal Areas of Air-Burst Shells

IN PREPARATION for the artillery mortar-FOB comparison and for similar studies, OROO worked out the lethal areas of a number of shells. (Lethal area is that area which when multiplied by the target density will give the expected number of casualties.)

The shells were air bursts, and the targets were men standing, crouching, and prone on average ground, men firing from trenches, men crossing in trenches, and the 2½-ton 6 × 6 truck.

Examples of findings are given in Figs. 5 and 6.

The study* presents a good deal of basic data, among it tables showing optimum bursts heights for various target conditions and also a range of heights. For example, the optimum burst height in the case of a 105 mm howitzer shell against personnel (one third of whom are standing, one third crouching, and one third prone) is 12 feet. But a shell bursting at any height between 10 and 21 feet will be

* [illegible]

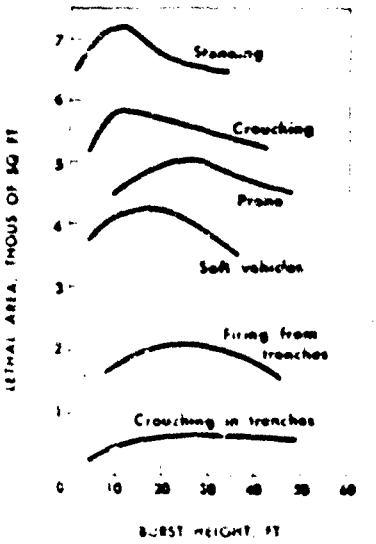


Fig. 5.—From curves like these, showing how lethal area varies with burst height in the case of the 105-mm howitzer, the optimum burst height for a given weapon against a given target can be determined. The angle of arrival here is 25 degrees. Notice that a man standing up is about 1½ times as vulnerable as a man lying down, 4 times as vulnerable as a man firing from a trench, and 16 times as vulnerable as a man crouching in a trench.

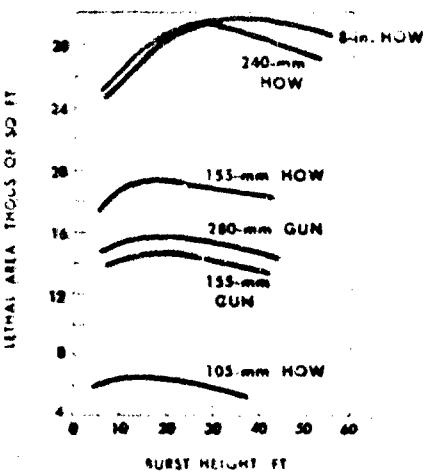


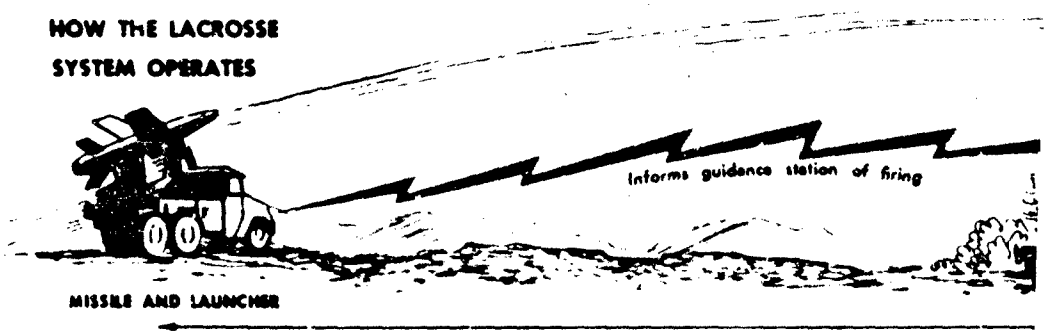
Fig. 6. These curves show how average lethal areas vary with the weapon and the burst height against an attacking personnel target. Fifty percent of the men are prone, 50 percent crouching.

at least 50 percent efficient against each type of target.

Note that:

- As burst height increases, the lethal area of a shell quickly increases to a maximum. After that it drops off, but usually at a much slower rate than its initial increase.
- Against men crouching in trenches, the lethal area of a shell is not much increased by the angle of fall. Against men in the open, however, the higher the angle of fall, the larger the lethal area.

Predicting Casualties. Lethal area is a measure for only a single burst. To determine what percentage of casualties will be caused by the firing of many shells, it is necessary to work out the "casualty probability function," or the probability that a target located at any given point will become a casualty. The study finds that this long, difficult process can be greatly simplified by using an approximation instead of the actual function. In the three cases studied, the simplified method resulted in errors of less than 2 percent.



LACROSSE vs Artillery

Cost-effectiveness study rates the missile inferior to the 155–mm gun and the 8-inch howitzer when these can be emplaced within 8,000 to 14,000 meters of the target.

LACROSSE is a rocket-propelled guided missile being developed for use against fixed, hard targets relatively close to the MLR that cannot be defeated by conventional artillery without excessive effort.

The missile can be launched as far as 18 miles from a target. However, its accuracy is not affected by its total range but by the distance between guidance equipment and target and the maximum such distance is 5000 meters. At a guidance-to-target range of 1000 meters, the design CEP is 5 meters.

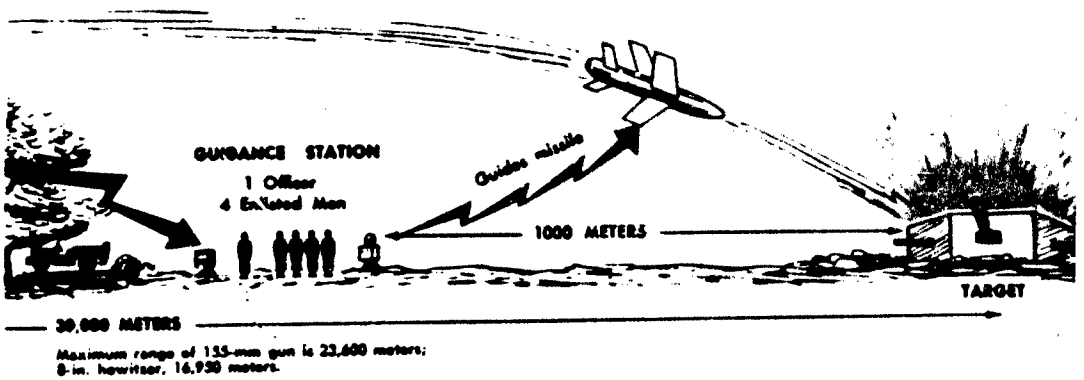
ORO has compared the new weapon with the 155–mm gun and the 8-inch howitzer on the basis of the dollars, manpower, and material required to achieve the same level of damage against three sizes of bunkers and pill boxes.* Among the assumptions: (a) the missile's guidance station can be located within 1000 meters of the target; (b) the forward observers for the artillery weapons can be located close enough to effect precision adjustment on the target; (c) LACROSSE achieves its design accuracy; only the shaped-charge warhead was considered for LACROSSE. Against a hit by the missile, the artillery weapons are required to get a 90 percent probability of at least one perforation.

The weapons were pitted against three targets, two of them with 7-foot and one with 5-foot walls. (The missile's 500-pound shaped-charge warhead is designed to penetrate 12 feet of reinforced concrete, but this capability would be needed to smash through 7 feet at the angle of impact assumed by the study.)

Figure 7 illustrates *the study's main finding:* when an 8-inch howitzer can move closer than 9000 meters from a target 30 × 10 feet or when the 155–mm gun can move closer than 8000 meters, there is a great disadvantage *costwise* to using LACROSSE. Furthermore, if the target area is halved at a fixed range, the cost of a hit by LACROSSE is tripled while the artillery is essentially unchanged.

NOTE that the study does not take into ac-

* ORO Study Number 132



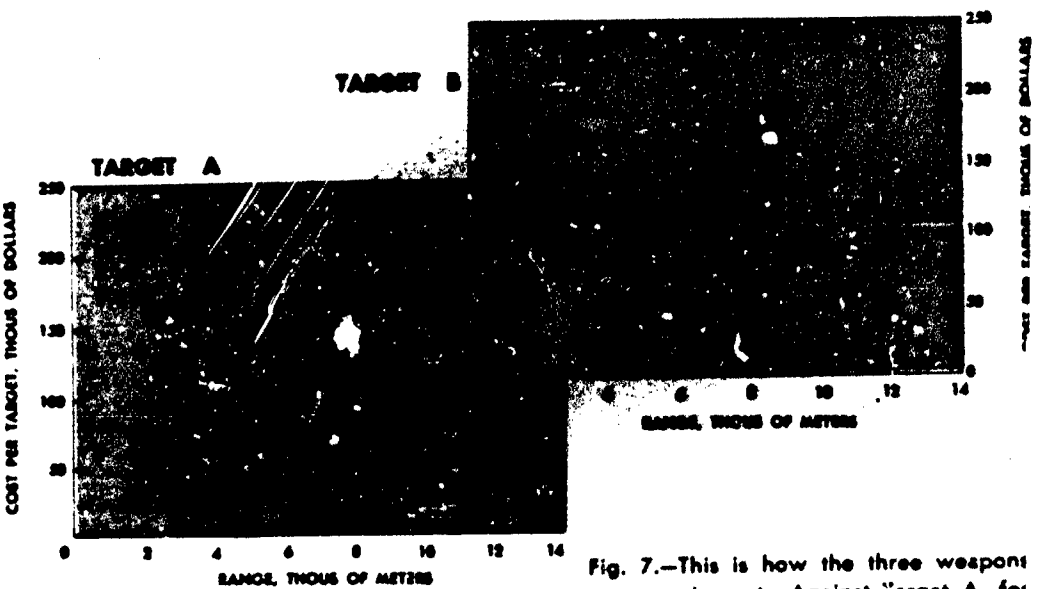


Fig. 7.—This is how the three weapons compare in cost. Against Target A, for example, the cost of a hit by LACROSSE remains steady at $38,000, if 250 rounds a month are fired. Under a range of about 8000 meters, in that case, the gun is cheaper than LACROSSE; under a range of 9500 meters, the howitzer is cheaper than either. (Target C, not shown, is the same size as Target B but has 5-foot walls. Here the howitzer is cheapest up to 14,000 meters.)

count the new system's possible tactical and logistical advantages, even in situations where artillery can be emplaced within effective range.

Recommended: As long as only a shaped-charge warhead is available for LACROSSE and if the LACROSSE system is added to the Army's family of weapons, doctrine should limit its use to situations where the 8-inch howitzer cannot be brought closer to the target than 9,000 to 14,000 meters.

How We Stand on NIKE

Breakdown of program into groups of critical items indicates we are doing as planned regarding men and materiel, but may be lagging in training, tactics and doctrine, and the construction of sites.

AS A TEST of how to present the status of typical Army programs most effectively to top management, ORO has analyzed the NIKE I program as of 30 September 1954.* (Another test case, the Reserve Forces program, is discussed on page 00.)

The study breaks the program down into two main objectives, each influenced by several so-called control groups, or clusters of items critical to the program's success. For example, the first objective is to form and deploy 61 NIKE battalions, and in analyzing progress toward this objective, the control groups are Men, Materiel, and Sites.

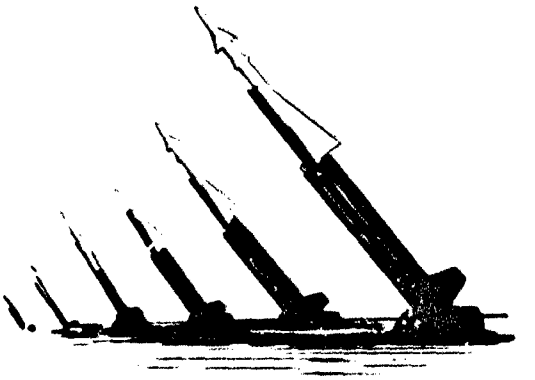
As Fig. 3 indicates, progress toward the first goal is about as planned, except in the case of construction.

The second objective is to maintain the NIKE battalions at ready standards, and the control groups are Operations and Training, Logistics, and Tactics and Doctrine. *On the basis of the data and information on policy available at the Pentagon—to which the study was limited by its mission—it is not possible to quantify either goals or relative progress of these groups.* For instance, on-site training equipment is a critical item, but available information does not show any formal coordinated FY55 plans for it as an element of the weapons system.

Available information does show that there is only one range on which actual firing takes place, and that congestion on this one is already evident. Furthermore, it indicates that standards for judging the operational readiness of a NIKE battalion are inadequate.

In carrying out a program, the Army now relies on informal staff coordination. Balanced progress would be more likely if all important elements were formally brought into control groups, and if status reports considered all these groups.

* ORO Study Number 71.2.



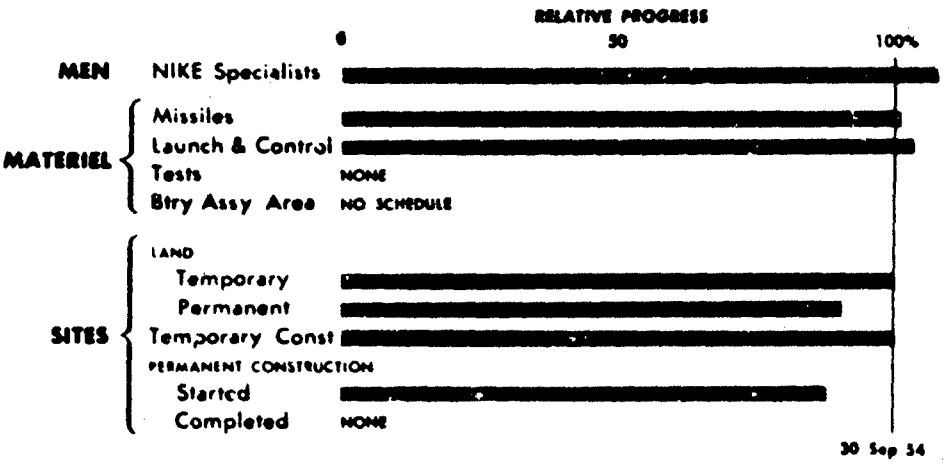
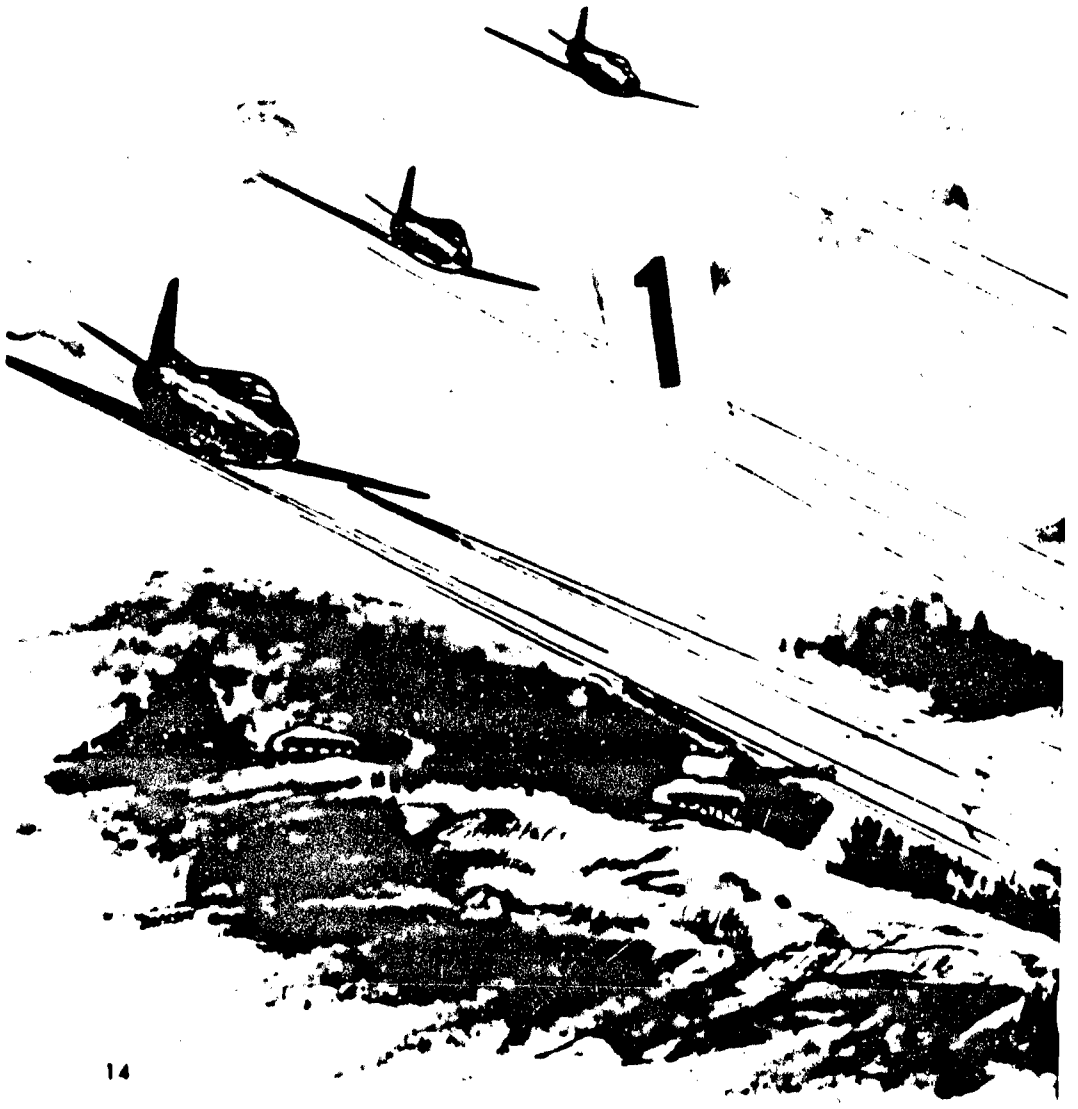


Fig. 8. - This chart summarizes progress toward the first objective —to form and deploy 61 NIKE battalions—as reached in the three control groups. By 30 Sep we had as many NIKE specialists and as much materiel as planned for that date but were lagging somewhat in the acquisition of permanent sites and in construction.

Spotting



a Low-Altitude Attack

Study of three MLRs shows that increasing the height of radar makes very little difference in the range at which surface-hugging planes can be detected.

IN SETTING up a defense against low-flying planes, how important is the height of radar antennae?

An investigation of typical MLRs along the Rhine and Weser rivers suggests that in these cases at least the answer is *not very.*

The study* used 1:50,000 topographical maps to analyze the terrain facing each of three MLRs and then determined the ability of radar stations to pick up planes approaching over that terrain.

Figure 10 illustrates the main finding: *In predicting radar range, a knowledge of the terrain is essential;* so-called smooth-sphere calculations, which don't take terrain into account, can be badly out of line.

Note that in most cases range is little influenced by the heighth of the antennae. For example, if an enemy plane flies at 150 feet and the height of the radar antennae is increased from 0 to 50 feet, the gain in

* ORO Study Number 18.1.

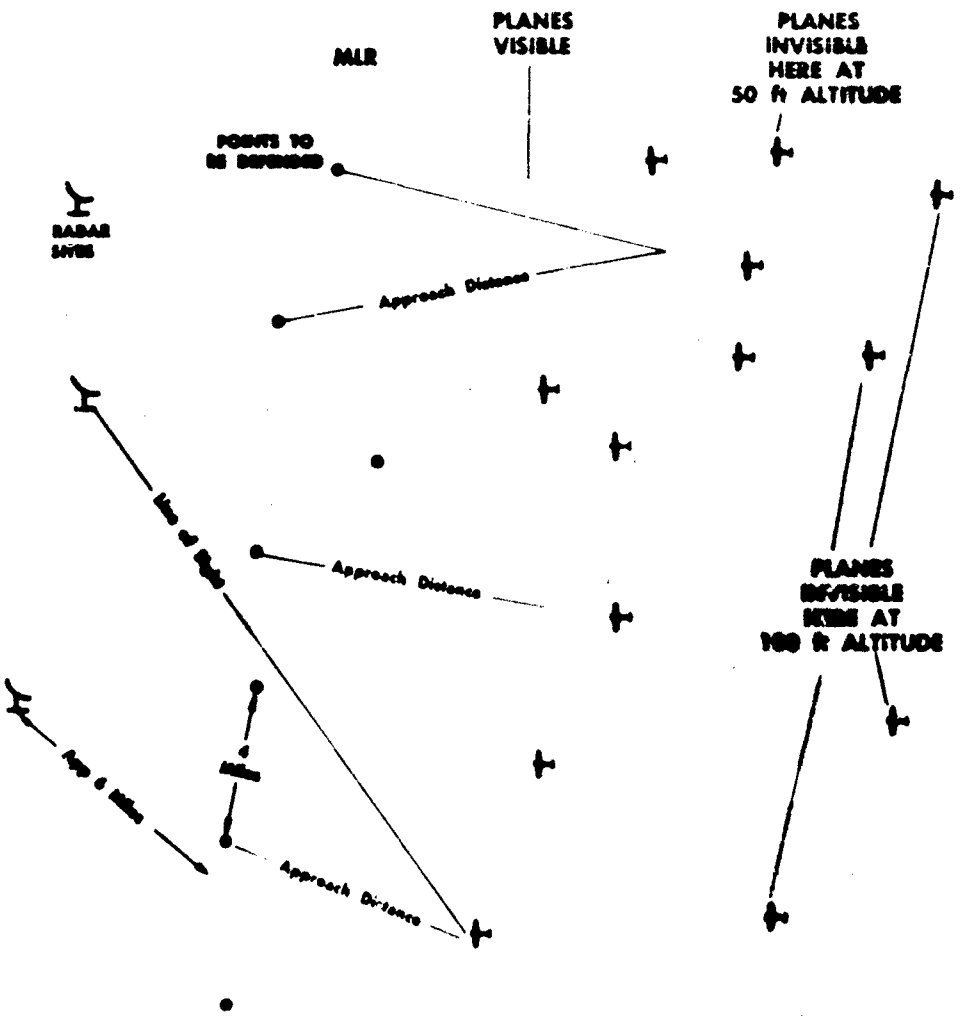


Fig. 9—From the calculations of the study, it would be possible to draw a map-diagram of each MLR. It would look something like this one, which is only illustrative, but be much more complex. The "approach distance" is the distance between a point to be defended and the nearest point at which an attacking plane becomes visible

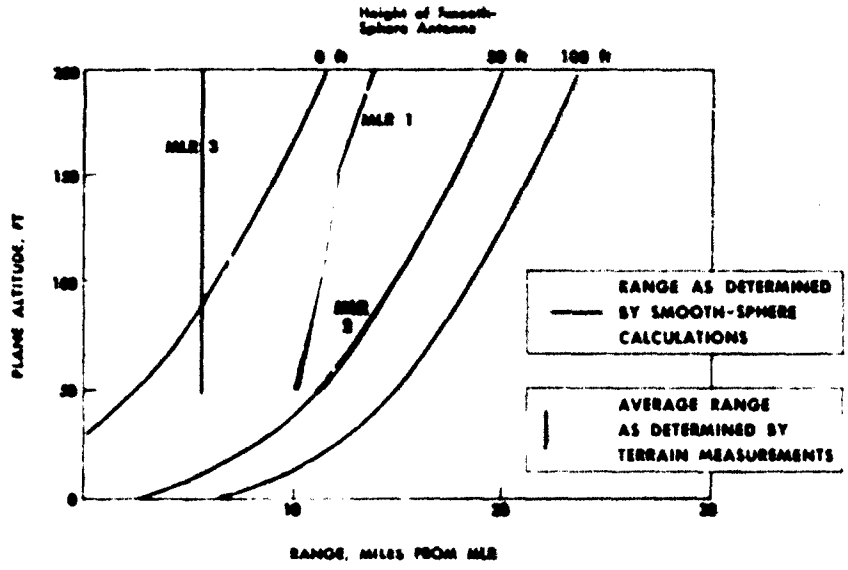


Fig. 10 – As this graph shows, theoretical analysis suggests that radar antennae be elevated because, by smooth-sphere calculations, the higher the antennae, the greater the range of detection. But notice that when terrain is taken into account along the MLRs studied, antenna height makes little or no difference. In the case of MLR 3, high ridges make the range practically independent of altitude.

range of detection is more than 3 miles – according to the smooth-sphere estimates. Actually, because of terrain, the increase is zero in the case of MLR 3, 0.1 mile for MLR 1, and 0.8 mile for MLR 2.

This is important because discussions of the ground-to-air missile system HAWK have assumed that as the system's radar was elevated, its range would considerably increase. *But if* HAWK *were used along the MLRs studied, there would be essentially no gain from raising the radars above ground level.*

Furthermore, with smooth-sphere calculations, approach distances anywhere along a given MLR are the same. Actually, they vary greatly—between 3 and 14 miles in one case studied. They vary greatly, too, between one MLR and another; one average in this study was 5 miles, another, 17. (The approach distance is the distance between a point to be defended and the nearest point at which an attacking plane becomes visible.)

An important implication: Effectiveness studies of systems such as HAWK should take into account the terrain where the weapons are to be used.

Delivery Systems for Nerve Gas

The CORPORAL is a better weapon loaded with an atomic warhead than with the present GB cluster warhead. Against targets where the gas looks good, delivery by TAC Air is cheaper than by missile.

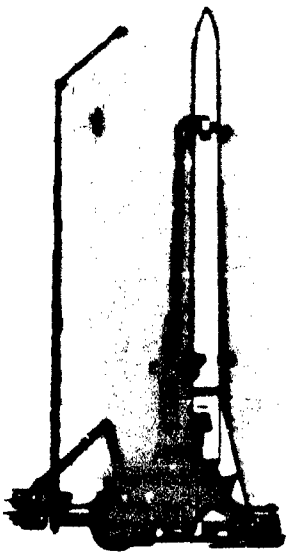
AMONG the means for delivering GB nerve gas is the CORPORAL guided missile. How effective is it compared with tactical air? Can the CORPORAL do as good a job with GB as with its atomic warhead?

ORO considers several likely targets—troops in reserve, an airdrop, and a roadblock—and calculates the cost of attacking them.*

Findings:

Against dispersed reserve troops, GB fire by CORPORAL is more costly than AW fire in terms of dollars per death; that is for a CEP greater than 300 yards. At the missile's design accuracy, a CEP of 160 yards, which has not yet been reached, a salvo of three nerve-gas warheads costs about the same on a dollars-per death basis as the nuclear warhead—*but requires three times as many targets if it is to cause the same number of deaths.*

NOTE that the target complex in the case just cited is a Soviet rifle battalion whose companies are dispersed in circles each having a radius of 150 yards and scattered around an annulus having an outer diameter of 2000 yards. The model was chosen to illustrate the expected trend toward thin targets in atomic warfare. With such dispersion, the casualties caused by GB in the area where it was released would not be greatly raised if wind carried the gas cloud over a wider area.



Against an airhead, a salvo of three GB CORPORALS could at most be expected to achieve 35 percent casualties in the case

* ORO Study Number 1311

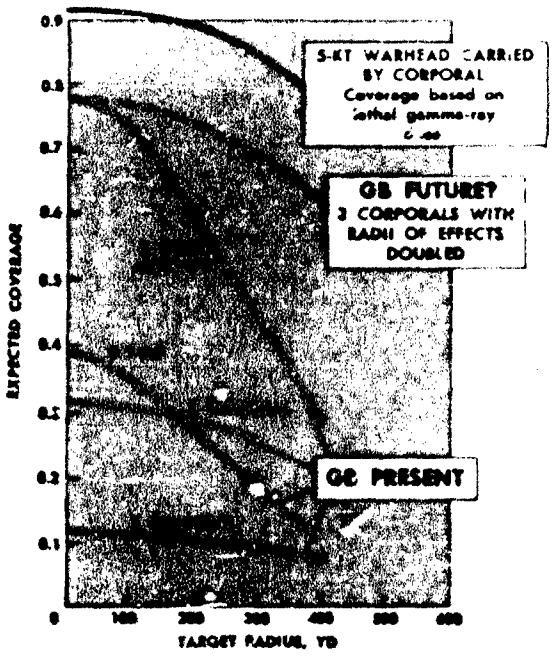


Fig. 11.—On the basis of the area they can cover with the given dosage of GB, this is how CORPORALs and F-84Fs compare. For example, if the target radius is about 175 yards, three missiles can cover 30 percent of the area with a dose likely to kill half the persons exposed to it. So can two aircraft. (The missiles would cost $240,000; the aircraft, $18,000.)

	MISSILES	AIRCRAFT
Radius of effects	130 yd	140 yd
CEP	330 yd	140 yd

of a battalion and 4 percent in the case of a division. With the same number of 5-KT warheads, against a division, the missile could achieve 80 percent casualties.

Against a roadblock, GB looks like a good weapon—capable of neutralizing the block without damaging the road or contaminating the area. But coverage of 40 percent of the area with CORPORAL will cost $240,000, whereas coverage of 90 percent with F-84F aircraft will cost only $54,000.

All three situations above are assumed to lie beyond the range of HONEST JOHN, *which can carry the same GB warhead as* CORPORAL *at one-eighth the cost.*

Principal conclusions: The present weapons system of CORPORAL with a clustered warhead of E51R6 bomblets carrying GB is not worth further consideration. Its radius of effects and rate of fire are both too low to classify it as an area weapon in competition with nuclear warheads or with GB delivered by tactical air.

Recommendations

1. For GB targets within the range of HONEST JOHN, use it instead of CORPORAL. For more distant targets, use the F-84F.

2. If surface-to-surface missiles of lower cost and greater accuracy are likely to be developed, continue R&D on both cluster and massive GB warheads. They should be intended for small rather than large area targets. To compete with AW warheads fired by CORPORAL against small targets, the radius of effects of CORPORAL's GB warhead would have to be doubled.

Evaluating Tanks

US and foreign types are compared speculatively in many tank-vs-tank duels whose outcome is determined solely by firepower and armor.

BASED on purely physical characteristics, how do Soviet and US—and other Western—tank-types compare? For instance, if tanks of the US M-48 type are pitted against those of the Soviet JS-3 type in many actions and under conditions that are the same for both sides, how will the average losses of one side compare with those of the other?

ORO explores this problem by resolving tank combat into basic actions involving small numbers of participants.* When only firepower and armor are taken into consideration, the study finds, a practicable measure of how a tank is likely to perform in these basic actions is offered by the tactically equitable duel. (The only differences between the two sides in such an engagement are their physical characteristics. The tanks fire alternately, and each side has an equal chance of firing first.)

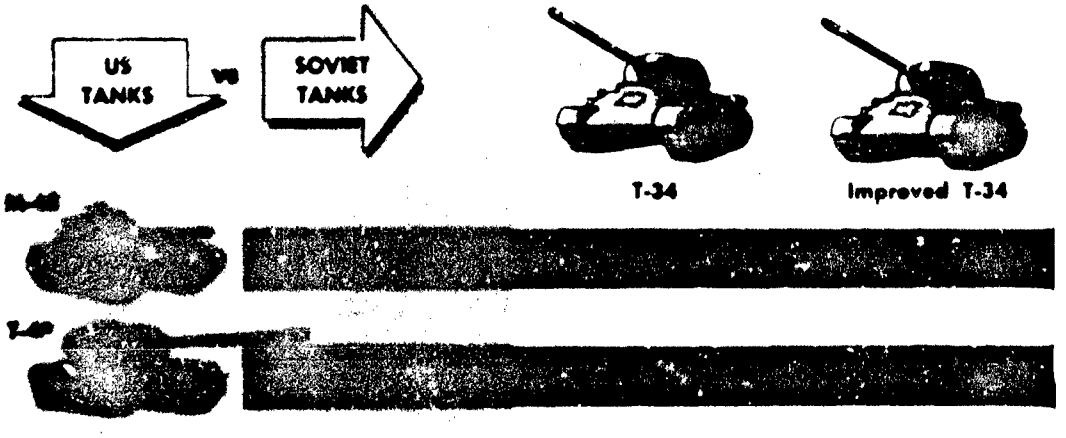
Each tank-type is pitted against an opponent under a variety of conditions at ranges varying from zero to 2000 yards, with various combinations of projectile types, and with and without range finders.

The action goes like this:

Side 1 fires. The hit probability is based on test and combat data. The kill prob-

* ORO Study Number 12.

BASIC EFFECTIVENESS RATIOS FOR US TANKS



ability is the hit probability times the vulnerability of the target.

Side 2 replies, if not knocked out.

Side 1, if still in the battle, fires again. Hit probability is assumed to increase with each shot.

And so on.

These tank types are considered:

US	*Soviet*	*British*
M-4A3E8	T-34	Centurion-III
M-41	JS-3	Comet
M-46	and	
M-47	hypothetically improved versions	*German*
M-48		Tiger (Model B)
T-43		

The Effectiveness Ratio

The probable losses of each type in a series of many theoretical duels are calculated and then averaged, the appropriately weighted averages being determined under two frequency distributions of ranges of engagement. One of these distributions is based on World War II data indicating that 600 yards was the average range; the other is a hypothetical one of the same type in which 1000 yards is assumed to be the average.

The effectiveness ratio of duels is then determined by dividing the average of probable losses of one side by that of the other.

Note that in actions involving unequal numbers of participants, the effectiveness ratio, from the point of view of side 1, is

$$\frac{\text{number of tanks lost by side 2}}{\text{number of tanks that caused that loss}} \text{ divided by } \frac{\text{number of tanks lost by side 1}}{\text{number of tanks that caused that loss}}$$

For example, the tanks of side 1 may have an effectiveness ratio of 1.5—meaning that, on the average, and when numbers are equal, side 1 can be expected to produce 1½ times as many casualties as side 2. But if side 1 consistently uses twice as many tanks as side 2, it can be expected on the average to produce three times as many casualties.

Evidence from a companion study* indicates that these effectiveness ratios, derived by calculation from a model, agree closely with those derived from actual combat.

* ORO-T-278.

AP Rounds ● Avg Range ● No Range Finders

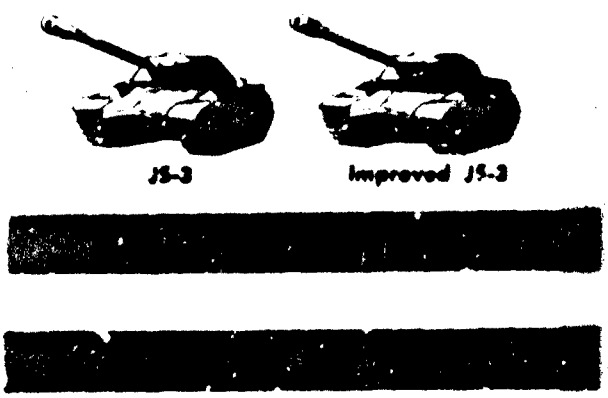
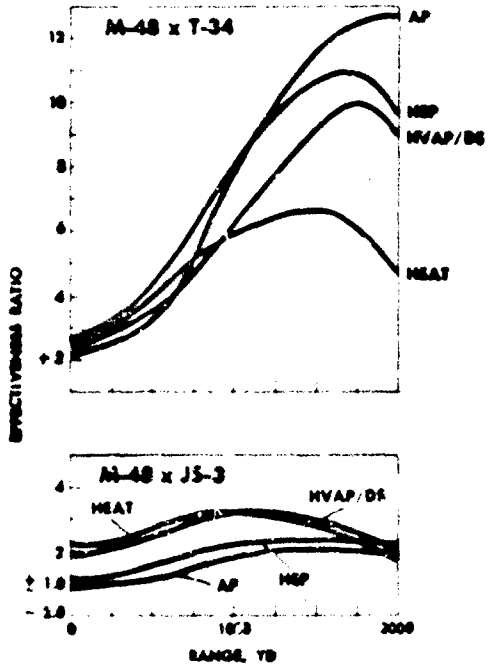


Fig. 12.—When Soviet tanks are assumed to have some of the improvements given US tanks in recent years, the superiority of US tanks drops greatly, as this table shows. The improved T-34 is given a gun equal to the 90-mm of the US M-46. The JS-3 is given a 120-mm gun equivalent to that of the US T-43. Hulls and turrets stay the same. The present M-48 would be a very uneven match for the improved JS-3.



EFFECT OF RANGE FINDERS

Fig. 13—This is what happens to the effectiveness ratios when the US tanks are given range finders and the Soviet tanks are assumed to be without them.

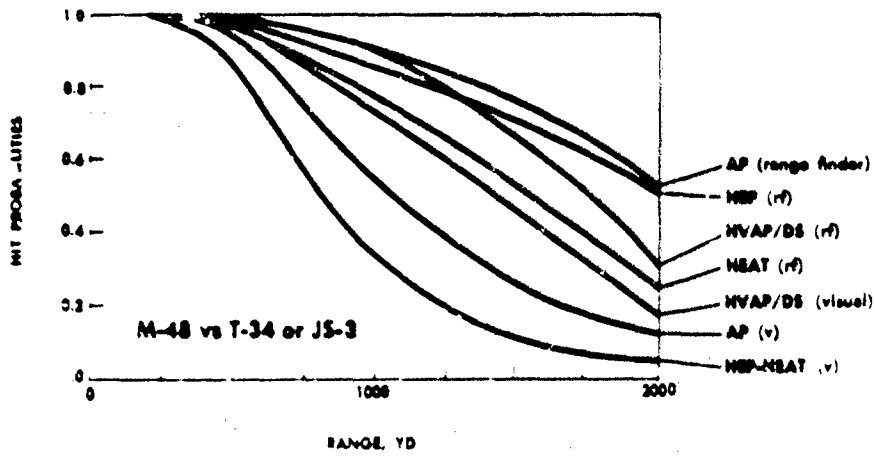
This earlier study found that in Korea the M-26 was from 3.5 to 3.9 times better than the M-4 in actions against the T-34. The theoretical comparisons in the present study show the M-46, which is substantially like the M-26, to be 3.2 times better than the M-4. (The greater differences found in Korea are attributed to tactical differences.)

Furthermore, the tactically equitable duel is judged to provide a good measure of effectiveness because in three-fourths of the basic tank actions on the Western front in World War II, and again in Korea, there were not more than three tanks to a side.

The Findings

Figure 12 shows how the newest US tanks, the M-48 and the T-43, compare with Soviet tanks, about which our information is some years old. In basic effectiveness—meaning that both sides are firing AP rounds and using visual ranging methods—the M-48 is about the same as the JS-3, while the T-43 is almost two and a half times better. (A minus sign in front of a ratio means that the first tank is inferior to the second.)

Notice, though, what happens when the Soviet tanks are assumed to have been improved. Now the M-48 is no longer a



EFFECT OF TYPES OF PROJECTILES

Fig. 14.—This graph shows how the probability of hitting a Soviet tank is affected by the type of projectile used.

match for the JS-3, but the T-43 still has an edge.

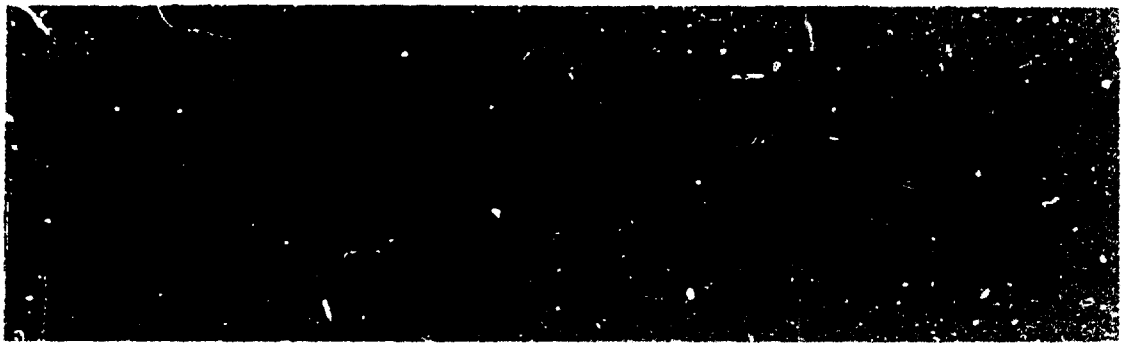
The effectiveness ratio changes significantly when one side uses a range finder, or resorts to projectile types other than AP rounds or is given a superior rate of aimed fire. For example, a range finder increases a tank's basic effectiveness 25 percent at an average range of 660 yards (provided the other tank doesn't have one), and 40 percent at 1000 yards. Again, when Soviet tanks fire AP rounds (and don't use range finders), the most effective rounds against them are HVAP DS. The next best average choice against the T-34 is AP; against the JS-3 it is HEAT.

Tables and charts present information on these points for all the tanks considered.

One big need in making evaluation studies of this kind. Firing tests to determine how the accuracy of antitank fire against a given tank can be expected to improve from one shot to the next. This is especially important at the longer ranges, where the initial hit probabilities are not large and where the outcome is much more dependent on the succeeding shots.

The study also points up the danger—particularly when new countermeasures are being considered—of depending on none too recent information about the performance of enemy weapons.

Building Up the Reserves



I. Getting More Men into Active Units

SOME OF the facts uncovered by an ORO study* of 5500 enlisted men who left the Army in July-October 1953 are presented in Fig. 15. Notice that during the first six months after active duty, only 22 of these men—traced through Military District headquarters records—are known to have joined infantry line units.

Here are other findings:

- The men who do not join reserve units are neither bet'er nor worse informed about reserve provisions than those who do.
- Men with college backgrounds are more unfavorable than others toward joining units.
- About half the men with reserve obligations have no preference for either the Army Reserve or the National Guard. Among those indicating a preference, most choose the Army Reserve.

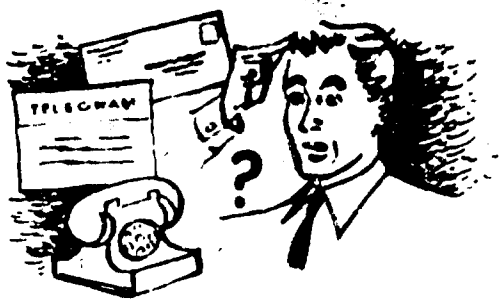
Main recommendations for increasing the effectiveness of the reserve program:

Request legislation designed to ensure an active ready reserve built upon trained units, balanced in number and strength between combat and support units; to equalize the chance of recall of obligated veterans and the call of deferred men; and to

* ORO T 251.

Veterans Shun Participation

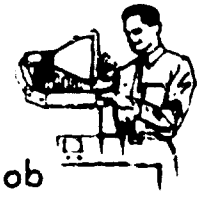
1 of 5500 soldiers interviewed at time of separation—40 didn't know how to get in touch with reserve components in home communities



2 10 reported intentions to join active reserve units

Fig. 15.—These findings come from a survey of 5500 men interviewed as they passed through 15 transfer centers across the country, in July-October 1953, and followed up six months later.

Why Join a Reserve Unit?



Can learn something to get a better civilian job

Fig. 16.—Soldiers going through transfer centers were asked to check a list of attractions for joining reserve units. Those shown here—particularly the first three—were the most popular at the time of separation. Implication: Show a man how he can better himself by serving in a reserve unit and he'll be more likely to join up.

in Reserve Units

SIX MONTHS LATER . . .

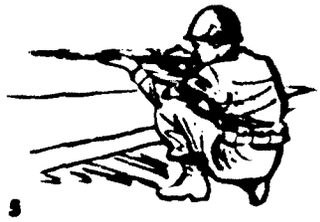
3

[redacted] had actually joined reserve units

ACTIVE RESERVE

4

[redacted] were in no active reserve unit but were vulnerable to recall—they were in so-called control groups



5

[redacted] were in infantry line units

6

[redacted] all others: short-term obligators; reenlisted; retired; other types of discharges; entered National Guard; could not be located in Military District records

Can earn promotion or a commission

Can line up a better MOS if I'm ever recalled

Can hold rating 

Can earn pay

support all requirements with means of enforcement.

Ensure personal contacts between veterans and representatives of reserve components.

Draw in nonveterans by providing that at least some classes of men deferred under Selective Service must participate actively in the reserve program. (Soldiers and veterans ask why they should join units when deferred men have no reserve obligations whatever.)

Strengthen the effort to inform soldiers about reserve affairs. Suggestions:

Persuade commanders that an understanding of reserve responsibility is essential to national defense and that it is their obligation to get this understanding across to their men.

If control groups are continued, present the risks of this status as against unit participation, since men supp.. their choice is merely between doing ..ching and training.

Stress the national and personal values underlying participation.

Start the information program early: by the time a man gets to the transfer center he doesn't want to listen—he wants to get home.

II. Rating the Reserves' Over-All Value

WHAT kind of reporting system does top Army management need if it is to make sound decisions about the Reserve Forces program? An ORO study* proposes this answer: *A system that is concerned not only with the number of men in the program but also with their value.*

To determine value, the study suggests a system similar to the standard cost systems used in industry. These establish an attainable performance potential for any given operation, and this potential is used in evaluating future operations.

The study sets a reservist's potential at 100—an index number applying to a man who has just joined the reserve after two years of active service. As he forgets some of his military knowledge and skills, he loses some of this value, so that he is worth much less in his sixth year as a reservist than in his first. (The contrary, of course, is true of the man who enters the Reserve Forces without military experience.)

The study estimates index values for each year a man is in the reserves and for three classes of reservists—participants in the training program, nonparticipants, and men without previous service—and then applies these values to the Reserve Force. It also offers methods of preparing easy-to-follow reports that take into account the adequacy of facilities and the equipment

* ORO T-321.

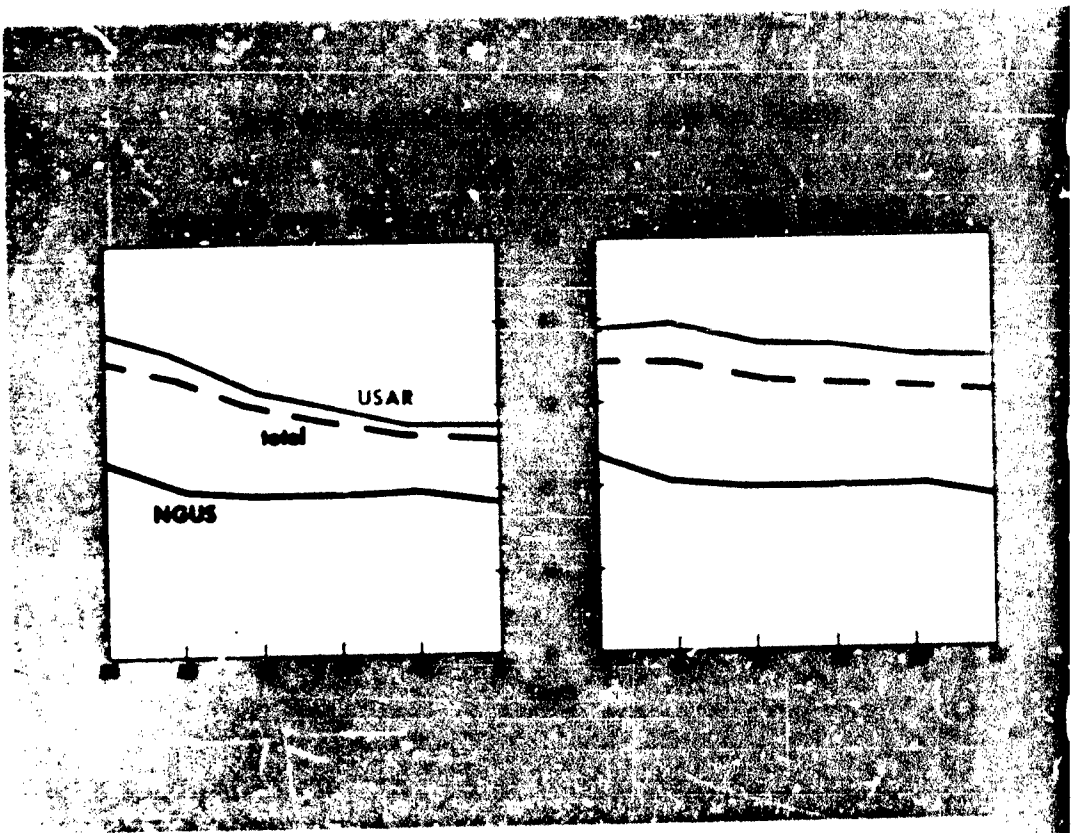


Fig. 17.—The proposed system makes it possible to determine the value of the reserve at any given time, at any given rate of participation in its training program, and for any given mobilization requirements. These charts are an example. They show the value of the presently planned reserve over a five-year period and for two methods of recall: first, across the board; second, in a descending order of value—the best men first.

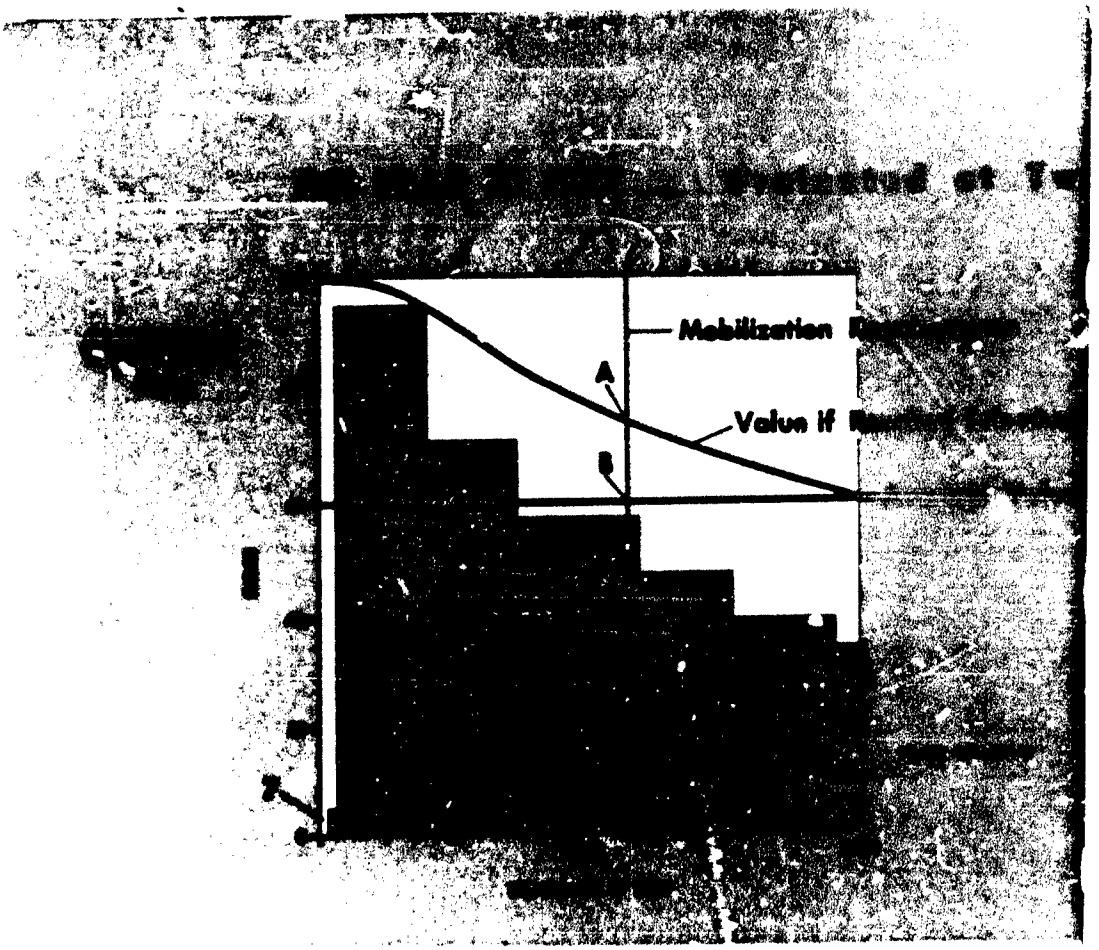
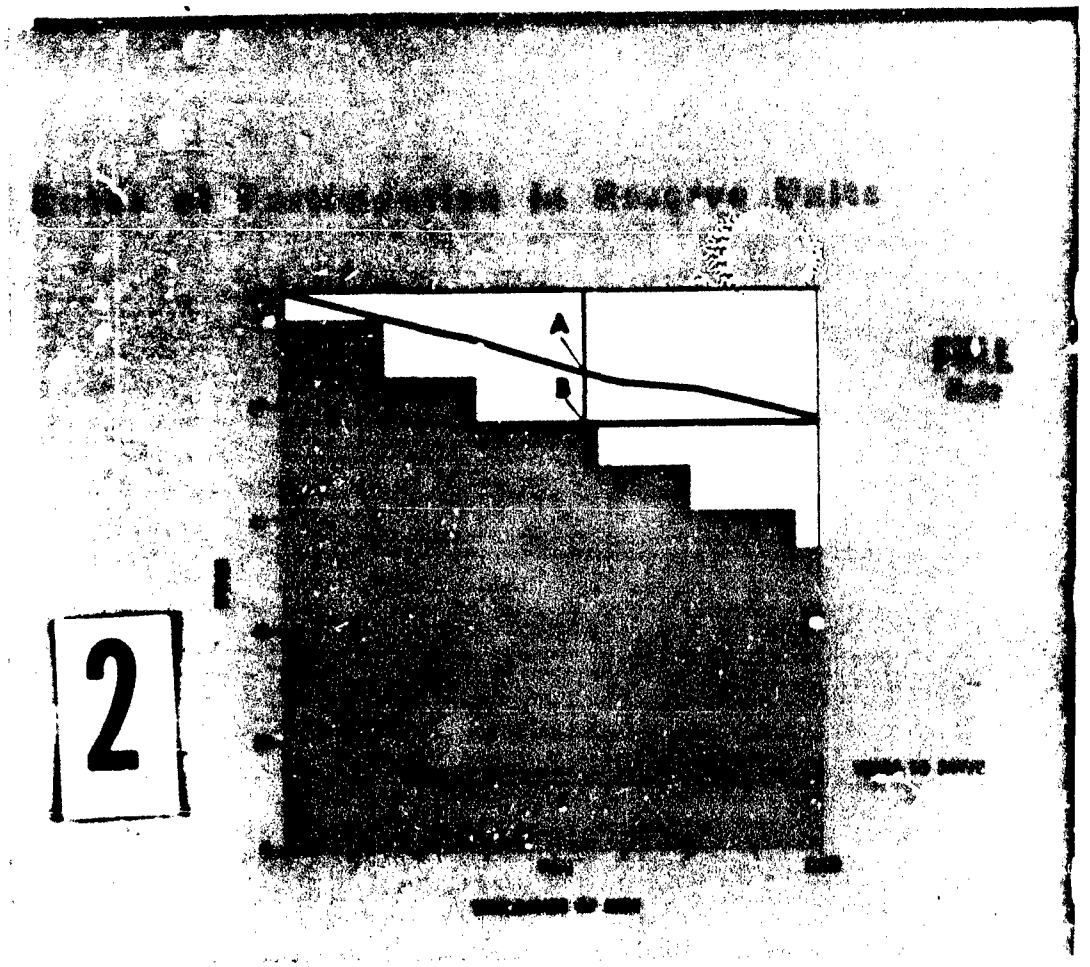


Fig. 18.—This example (above, left) of the study's work presents the index value of each yearly group in the USAR. For instance, the group that has six years to go is rated at close to 100 because it has only recently left active duty, but the average value of the entire force is only 60. If men were recalled selectively to meet the mobilization requirement, the value of the mobilized force could be raised almost 20 points—from B to A on the chart. The saving in training time would be an estimated $347,000,000. The chart at the right shows how the value of the total force would be increased if all men were in reserve units.



of the force as well as the strength and the effectiveness of its personnel.

Note that in this case ORO has been concerned primarily with methods. Estimates concerning the length of time a man retains military skills after leaving active service may have to be revised when test data become available. But the proposed system is believed to offer a great improvement over the present one.

Figure 17 is an example of how it can be used. It shows the value of the Reserve Force under two methods of recall. If reservists with the highest index ratings are recalled first, the savings—under present mobilization plans—are at least two weeks in mobilization time and more than 100 million man-hours in training time. Figure 18 provides an evaluation for a given year.

The system can also be used to predict the amount of retraining time needed to prepare the Reserve Force for combat at any given date. In fact *it would help managements determine what action to take in regard to almost any question concerning the reserve, and it would help in predicting the results.*

Characteristics

Study of troops in Korea reemphasizes the importance of emotional stability and of combat experience.

LATE IN 1952 an ORO team visited 12 rifle companies in Korea to obtain data on the performance of riflemen in combat. The analysts first defined an effective rifleman on the basis of specific combat behaviors identified in previous research and then went on to evaluate tests aimed at distinguishing effective soldiers from ineffective. The results have been reported in part.*

The team also obtained information about the aptitudes, attitudes, and emotional stability of the men whose performance was being studied.* Purpose: to determine whether or not good and poor riflemen differ in respect to certain of their measureable characteristics. For example, does a highly intelligent person make a better-than-average rifleman?

Much of this information was drawn out by specially-administered tests and questionnaires. The team also checked the scores the men had received on the Army Classification Battery, notably on those sections that provide a measure of general mental aptitude.

Among the findings:

The good rifleman appears to be emotionally more stable. He is better integrated into his group, feels a part of it, would like to continue to associate with his buddies in civilian life. The poor rifleman is more likely than the good one to be fearful, pessimistic, anxious, and to withdraw from contact with his associates.

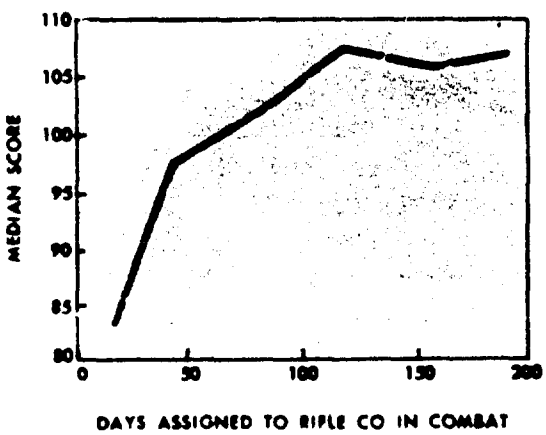
The best riflemen are neither younger nor older than the poorest. (In the sample studied, two-thirds of the men were between 18 and 25; larger proportions of younger or older men might have changed the finding.)

A man's attitude toward authority is no measure of his ability as a rifleman. In other words, men fight equally well, whether or not they accept authority easily. (The findings reveal no detrimental effects resulting from the authoritarian atmosphere in Army units.)

* ORO T-250, ORO-T-260, ORO-T-61 (FEC).

* ORO Study Number 11.9.

Fig. 19.—Combat experience, as this graph shows, brought a sharp rise in the scores made by riflemen on a test of combat effectiveness. This rise levelled off after about 120 days of combat.



of the Effective Rifleman

2

Poor riflemen tend to over-rate their effectiveness. The opposite also is true: good riflemen tend to rate themselves lower than they are rated by their associates.

Fighting ability seems unrelated to mental ability in groups such as were found in Korea--at least as measured by the Reading and Vocabulary, the Arithmetic Reasoning, and the Pattern Analysis tests of the Army Classification Battery. The scores of the Mechanical Aptitude and the Shop Mechanics tests also failed to differentiate between good and poor riflemen.

Good riflemen have had more combat experience. In fact, the length of combat experience was the one factor, of all those studied, most closely associated with performance.

Conclusions

1. A rifleman's capacity to deal with the stresses of combat with a minimum of emotional disturbance is more important than the characteristics now routinely measured for purposes of selection and assignment. A test of emotional reactions should make it possible to identify many potentially poor combat riflemen. No such test exists for general use but one probably could be —and ought to be—developed.

2. Combat experience brings a steep rise in effectiveness, followed by a levelling-off period. Once the rise has levelled off —120 days under Korean conditions—rest periods might be most advantageous.

Human Factors: A Summing Up

AN EARLIER semiannual report* discussed the contributions made by ORO to the inter-service study of the Working Group on Human Behavior under Conditions of Military Service.

These contributions have now been brought together in systematic form and published under the title, *Human Factors in Military Operations* (unclassified).† The volume's 22 chapters cover such subjects as—

Some Crucial Problems in Manpower.

American Culture, National Character, and Problems of Mobilization.

Skilled Behavior under Conditions of Stress.

Training Aids and Devices.

Military Life and Mental Health.

The Military Hierarchy and "Caste" Divisions.

Problems in the Utilization of Troops in Foreign Areas.

In general, each chapter seeks to answer, "What we do know now about this subject, and where ought we go from here?"

* Vol. IV, No. 11, 31 December 1951.
† ORO-T-259

Alternatives to Surrender

Many Americans seem to have become prisoners unnecessarily. With more emphasis on what an isolated unit can do, and with more rugged training, men would be less likely to give up.

CLOSELY tying in with the problem of how a soldier who becomes a POW should conduct himself is the problem of how he can keep from becoming a POW.

ORO has examined one phase of the question* by studying the circumstances under which a number of Americans have been taken prisoner and by considering the potentialities of the isolated unit—the group that gives rise to a majority of the US prisoners taken in ground combat.

Findings are based largely on an analysis of 1300 G–2 interviews with repatriated US personnel in the Korean campaign and 350 G–2 exrepatriation reports dealing with World War II men (ETO).

This seems to be the picture:

● The great majority of the American POWs were taken in groups. After their units were cut off, they had at least an hour in which to act before their situation became helpless; some had a week. In only a minority of cases was there a shortage of either ammunition or food. Yet sizeable numbers—something like half the POWs who gave information on this point—either took no action to avoid capture or else put up only brief resistance.

● Isolated units tended to stick to the roads, and members of such units tended to remain with wounded comrades—circumstances that made capture easier.

● Lack of leadership or direction, as Fig. 20 shows, was the reason most often given for surrender.

Alternative Courses

It is dangerous to surrender to a Communist foe; the chances of returning alive and unbroken in body and mind appear to be less than even. But generally there are some alternatives to surrender—for example, evasion and escape, or breaking out through enemy lines, or digging in to fight, or penetrating deeper into enemy territory to try guerrilla-type action, or to wait for a better opportunity to break out.

Present Army training, the study finds, does not sufficiently stress either the physical and mental conditioning or the tactics of survival necessary for any of those alternatives. More emphasis on combat patrolling, map-reading and use of the compass, supply economy, and close combat would give the soldier more confidence in his ability to try something besides surrender.

* ORO-T-297.

1

Fig. 20.—American prisoners who talked about why they surrendered gave these as the primary reasons. Many times a combination of factors was at work.

Recommendations

Army doctrine should include a guide to the alternative courses of action.

Training in survival techniques and aggressive small-unit tactics should be more rugged and thorough.

The problem of maintaining contact between isolated units and higher headquarters should continue to receive intensive R&D effort.

As a means of analyzing operations, training, and leadership, returned prisoners should be questioned about the circumstances of their capture.

Occupying the USSR:

Study of captured documents shows the problems met by the Nazi occupation forces and suggests lessons for American planners.

PRESUMABLY the experience of the Germans in administering occupied Russian territory in World War II can provide lessons for Americans charged with planning for civil affairs and military government in event of war. To find these lessons, ORO has examined German war documents and from them has drawn a picture* of the organizational setup during the occupation; the use of Russian agencies and individuals to further German aims; the problems met in the fields of health, education, public safety, and manpower; and the conclusions reached by the Germans.

* ORO T 301.

Long-range German plans to subjugate the "inferior" Russian people had a markedly adverse effect on the short-run occupation objective of supporting the German war effort. The Germans failed to capitalize on the Russians' need for a spiritual and ideological program replacing Communism.

Occupation policies should contain elements designed to win the immediate support of large segments of the people. Emphasize freedom of religion, government by elected representatives, individual landholdings, fulfillment of nationalist aspirations.

the German Experience

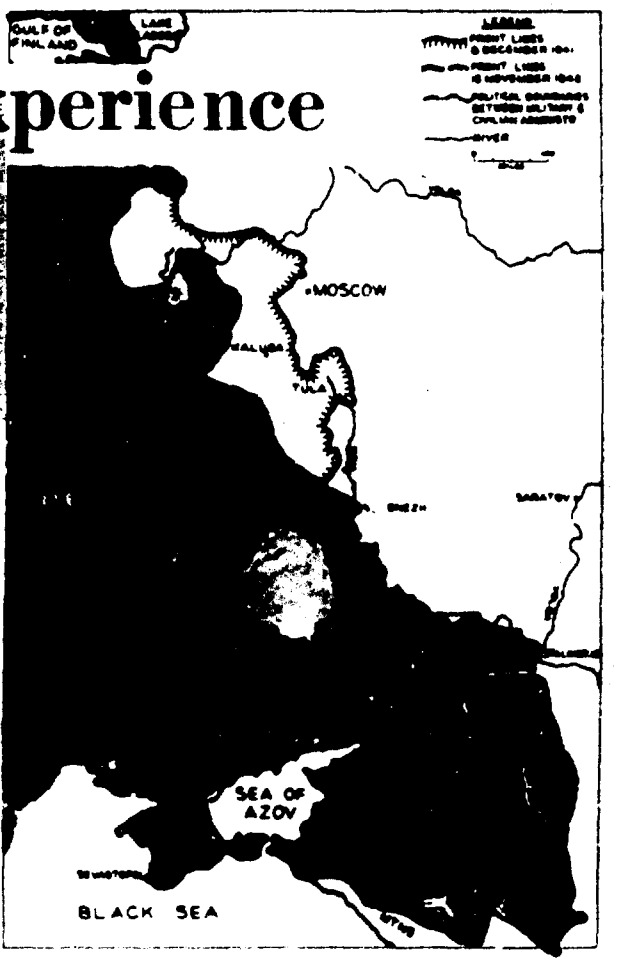


Fig. 21.—German occupation of Soviet territory began in June 1941 and lasted in a few areas along the western borders until 1945. The map shows the extent of the area under occupation in 1942; it had a peacetime population of at least 60 million people.

German planning, based on the assumption that military control would be needed only a few months, was too rigid and did not permit changes based on field experience. Administrative responsibilities were too divided. The Army was bound by directives that did not take its needs into account.

The organization should be based on the possibility of a long-term occupation and need for flexibility to meet varying requirements. It should provide for a single occupation authority responsible to the theater commander. This authority should be responsible for issuing all major policy directives to all agencies concerned.

The Germans had to use indigenous agencies far more than planned. Greater attention to the development of such agencies would have helped in the pacification of rear areas, led to increased production, and reduced the number of German administrators and security troops. Politically reliable persons were not hard to find, but good administrators were. Russian émigrés did not work out well.	Plans should include provisions for recruiting and training Russian personnel for government positions, and for rewarding them. Local administrators should be allowed a high degree of authority and responsibility. They should be given adequate supplies. Orders to them should come along a single channel.
Some of the operations were hampered by the brutal behavior of individual German military and civilian personnel. Also, there was a wide gap between promise and performance.	Occupying troops and personnel should be indoctrinated on how to treat the population. Close coordination will be needed among psywar, public information, and military government planners and operators.
Initial Russian willingness to cooperate changed—in large part because of German plans for political domination and economic exploitation and because of Russian military victories; in part because of Russian partisan activities in rear areas and limited German manpower.	Provide for adequate security troops and strong public safety organization in rear areas, a uniform system of compulsory registration of the occupied population, and training of local personnel in police, firefighting, and air-defense activities.
The Germans had intended to offer the people only very limited educational opportunities. They underestimated Soviet educational standards and public pressure for education.	A comprehensive educational program should be implemented early. Buildings, textbooks, and other school materials should be planned for.
The burden of public health work fell on a small number of Germans. There was a great shortage of civilian hospitals. Professional personnel had gone with the army or fled.	Planners need to consider means of replacing evacuated local medical and technical personnel; also, how to obtain medical supplies and hospital facilities.

8. ———————————————————

The Germans found severe labor shortages in the rear areas. Uniform pay scales were unrealistic because supplies were not uniformly available.

Priorities for the utilization of local manpower should be set up. Schools for giving training in the technical skills may be needed. Where required, rations should supplement payment in currency. As far as possible, workers should be assigned to home areas.

Russians in Security Work

A companion study* examines in detail the use of Soviet nationals for security and public safety activities in rear areas. This use was contrary to German plans but it released troops for front-line service at a time when partisan activities were increasing. The Russian-manned police forces were called the *Ordnungsdienst* (OD).

Despite the invaders' mistakes, the Russian collaborators contributed considerably to the German attempt to consolidate the occupied territories. In the beginning it was fairly easy to get recruits. They seemed to consider themselves not as mercenaries in the service of the Germans but as policemen working for the best interest of their community. Units performed best in regular police tasks, in guard duties, and in local fortified positions. Combat performance against partisans depended on the morale of the unit and the degree of German supervision and leadership.

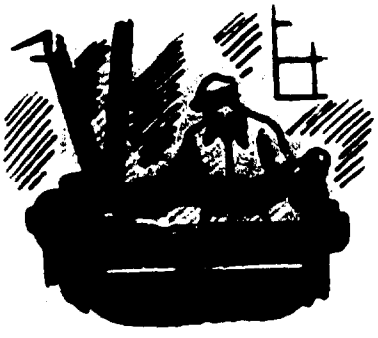
Among the points that detracted from the effectiveness of OD units: (a) the lack of planning for them; (b) the initial treatment of OD personnel as of inferior status; (c) German jurisdictional conflicts, between the Office of Military Administration and the German tactical commands; (d) a shortage of German officers qualified to lead the units; (e) shortages of weapons, ammunition, food, clothing; (f) lack of trained Russian personnel.

Among the Recommendations

Decide well in advance whether or not Russian manpower is to be utilized in auxiliary police forces. If it is, vest overall responsibility in a single military agency. Organize the units mainly on a local basis and make the recruitment system local and voluntary as long as possible; if necessary, supplement the voluntary system with a draft. Provide training facilities and adequate supplies. Plan special inducements, such as rations for families and early consideration in any land allotments. Use personnel for the most part in activities that protect their own homes and their own interests in the community.

* ORO T 320.

WORKERS



Class conscious. Favor collective forms of ownership. Proud of their skills. Admire American technology but believe the Communist story that US workers are ground down by capitalists.

WHITE-COLLAR WORKERS

Likely to be nationalistic. Sympathies tend to lie with the West. Have slim chance now of earning anything above a bare living. Drive for industrialization threatens to force them into unskilled labor jobs.

PEASANTS

Highly materialistic. Fa private ownership and l reform. Greatly dislike lectivization drives and livery quotas. Afraid farms will be run like tories. Most of them car reached by radio.

Target: Czechoslovakia

Information likely to be helpful to the planners and operators of a psychological warfare campaign is gathered into an area manual.

AT THE request of the Office of the Chief of Psychological Warfare, ORO has prepared an area manual* on Czechoslovakia. Like the China manual published earlier, this attempts to supply useful data on a potential target area for personnel who might some day be engaged in a psywar campaign against that area.

Volume I, unclassified, surveys the geographical, historical, and economic fact that have molded present-day Czechoslo kia.

Volume II, also unclassified, consi political, cultural, and sociological deve ments. It includes sections on ideolog conflicts, education, language, popular ings, and notable personalities.

Volume III, classified CONFIDENT

* ORO T-300.

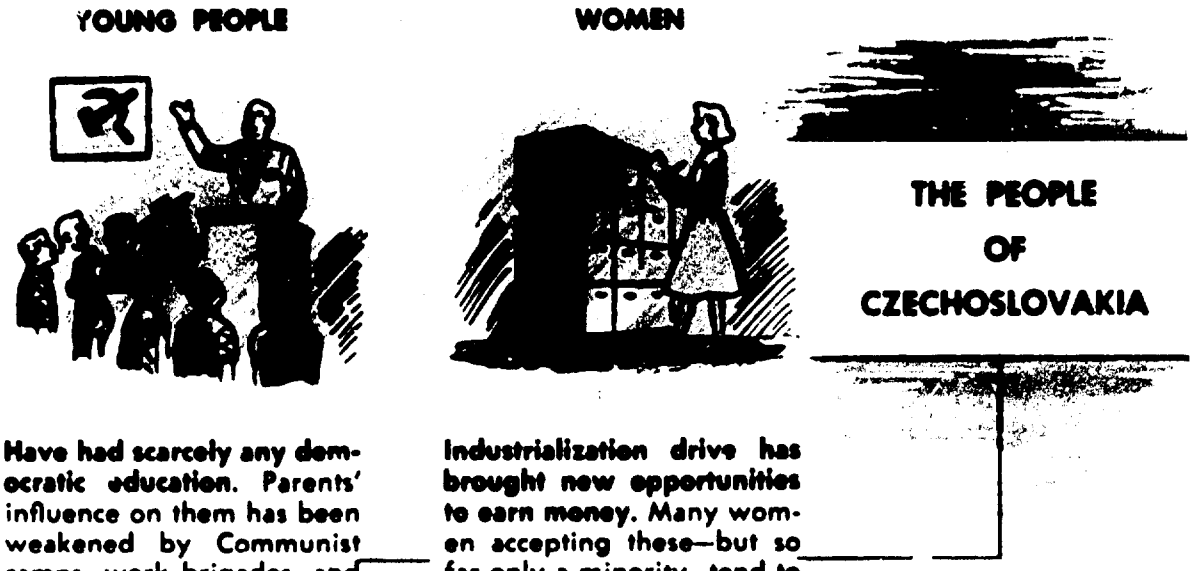


Fig. 22.—These descriptions of some of the social groups in Czechoslovakia are highly condensed versions of material appearing in the manual.

covers the army, discusses mass communications, and presents sketches of important present-day leaders. The final section, drawing on all the information previously presented, discusses *Principles Bearing on Planning for Psychological Warfare against Czechoslovakia.*

Figure 22 offers one sample of the type of information contained in the manual's final section. Here are a few more:

The people of Czechoslovakia are highly literate. They will react unfavorably to grammatical errors and poor accent and style. They will react unfavorably, also, to sensational handling of news developments.

The United States, in the eyes of most of the people, has a long record of acting in Czechoslovakia's best interests. Russians, too, have traditionally been friends.

Czech and Slovak soldiers traditionally desert a foreign military organization that they don't like and then join up with one that they do. The Czechs could never be expected to surrender to a German-speaking unit, even one under NATO.

Party leadership suffers from constant doubts concerning the loyalty of members. By accentuating these doubts, psywar may lead to the overloading of the Communist internal security system.

Disseminating Psywar Leaflets

Field tests provide a basis for evaluating distribution techniques. The required density to ensure a high probability of man-leaflet contact seems to be no more than 60 leaflets per 1000 square meters.

PRESENT methods of delivering leaflets in psychological warfare operations normally drop anywhere from 20 to 1000 for every 1000 square meters, depending on the method. Question: What minimum number *ought* to be delivered to provide a high probability that a man will come across a leaflet?

To find out, ORO conducted a series of field tests* in Korea under varying conditions of target—from front-line battalions to Korean villages—and of terrain. Some 6500 South Koreans and Americans, in 12 groups, participated. They were instructed to pick up all leaflets they happened to see, provided these were retrievable without undue effort. They were cautioned against deliberately searching for leaflets.

Analysis of data leads to these findings:

● The best density for leaflets intended for an average field unit ranges from 5 per 1000 square meters in the case of level terrain to 12 per 1000 square meters in the case of mountainous terrain. *This sup-*

* ORO T 293.

poses that troop density is not more than two men per 1000 square meters, and that it is desired to have each man find one leaflet.

● For village, town, and city type targets, the density should range from 6 to 30 leaflets per 1000 square meters.

● The application of a variety of correction factors for differing types of audiences and for heavier troop densities could double these specifications. *The over-all range, therefore, is from 5 to 60 leaflets per 1000 square meters. It is recommended that this be made the basis for evaluating weapons and techniques for leaflet distribution.*

Psywar's Influence in Malaya

BY AN arrangement with the Scientific Adviser to the British Army Council, ORO has extended to Malaya its analysis of psychological warfare and other factors affecting surrender and disaffection.

The new study* sampled 145 Communist terrorists taken prisoner by the British Security Forces between 15 July 1953 and 15 February 1954. It used a questionnaire designed to rate each of these in terms of seven factors—among them (a) the degree to which the individual, before entering the jungle, had been in accord with the aims and ideology of the Malayan Communist Party; (b) the degree to which he felt he had been poorly treated by his own forces; (c) the amount and intensity of his battle experience.

Sample question and possible answers: While you were in the jungle, to what extent did you believe the Government messages about good treatment given to Communist fighting men who gave up?

.....I thought this was a complete lie.

.....I had considerable doubts about the truth of these messages.

.....I thought more and more that perhaps the messages were true.

.....These messages made me decide to get out of the fight.

Findings are in general agreement with those reached earlier in a study of North Korean and Chinese POWs in Korea.*

Main conclusion: Several factors work together to bring about disaffection and surrender. One of these is psychological warfare. The other three most important are inadequate treatment by one's own forces, intolerable physical conditions while in combat, and a relatively great amount of combat.

The lesson (presumably applicable to other areas as well as Malaya): Psychological warfare intended to bring about disaffection and surrender should stress:

1. All aspects of inadequate treatment the individual soldier receives from his own forces.

2. The intolerableness of life as a member of the opposing army.

3. The disadvantages and risks—to him—of battling a superior force.

* ORO T-296.

* ORO T-40 (FEC).

SHORT REPORTS . . .

Testing Officers' Knowledge about A-Weapons

IN THE spring of 1954, ORO helped administer a test of atomic information to some 1650 officers at Army service schools and the Military Academy.

The test comprised 25 multiple-choice items and 50 true-false items, some concerning the physical properties of atomic weapons and others dealing with weapons effects and atomic tactics. Developed by ORO, it originally had been given to the organization's professional employees as a means of determining the contents of a course of study offered then on nuclear weapons and tactics. Several Army installations had asked for copies.

Analysis* of the answers given by officers shows that—

—of the 75 questions, officers on the average answered 43 correctly. On a percentage basis, half the officers got grades of less than 55.

—the higher the rank of the officer, the higher the score. The average number of correct answers from second lieutenants was about 40; from colonels, 47.

—officers with specialized training in atomic matters did better than those without.

Army officers scored about one point higher, on the average, than the professional members of ORO's staff, who took an equivalent form of the test. ORO's reaction to the scores made by its employees was to require operations analysts to take a course on atomic matters. *Since the officers, too, displayed a good deal of misinformation about every aspect of atomic weapons, the Army might consider similar action.*

* ORO T-291.

War-Gaming a Small-Unit Action

THE MISSION of ORO-OCAFF is to determine—by means of war games and field experiments—the capabilities of US forces in a two-sided atomic war. In the course of this analysis the capabilities of small units using conventional weapons must be evaluated, and a war-gaming technique has been devised to assist in this work.*

The small-unit actions are played in great detail on a large-scale map, with combat-experienced officers making the necessary command decisions. Artillery attrition is calculated using lethal areas and fire dispersion factors based on combat or test data where available, or on the opinion of experienced personnel. The tank-tank and tank-antitank phase of an action is played shot by shot, with the seeing and hit probabilities based on the best available data. A random-number selector set in accordance with the probability of success of a given event determines whether a particular move succeeds or fails.

* ORO Study Number 63.

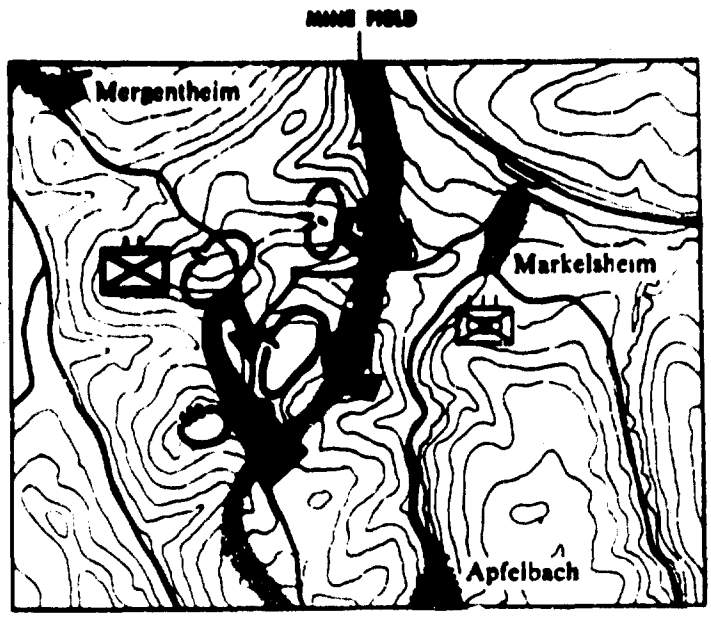


Fig. 23.—This is the game board for the small-unit action, in which a US battalion defends against a superior enemy force.

In a small-unit action that has just been gamed, a well-entrenched US battalion having eight battalion antitank weapons (BATs) and reinforced by a tank platoon was pitted against a Soviet mechanized regiment reinforced by a heavy tank battalion. The US battalion destroyed or immobilized all the Soviet medium and heavy tanks (52) and contained the Soviet infantry attack. At the end of the game, however, it was incapable of further defensive action without reinforcement.

The players—officers and civilian analysts—have been severely restricted by a lack of basic data on several important factors. One of these concerns the ability of an attacking tank to see an antitank weapon or defending tank once this weapon has been fired. Since this ability must be known before the influence of the BAT weapon on the battalion weapons system can be fully evaluated, a field test to determine time values is planned. The results of the test will make possible a realistic study of the tank-antitank aspect of small-unit actions and an assessment of the relative effectiveness of proposed new antitank weapons.

Other studies stemming from problems encountered in the battalion war game are the effect of shielding in relation to lethal areas of artillery shells and the general question of mine warfare as it concerns small-unit actions.

New Computational Methods for Symbolic Logic

SYMBOLIC logic is an analytical method in which symbols replace statements expressed in words. It can serve as an aid to the complex reasoning required for the solution of many non-numerical problems —for example, the analysis of intelligence reports. But its practical utilization has been severely limited because these problems often present such a large number of variables that extensive calculations are

needed; with existing computational methods, these have been difficult, and frequently impossible, to make.

A computational formalism being developed by ORO* should make it possible to formulate and analyze many problems in symbolic logic for which conventional methods have not been adequate. The attempt is not to contribute anything to the abstract theory of symbolic logic but to put its methodology to wider practical use.

The methods under development are suitable for use with an electric computer. They will be applicable to problems not only in the analysis of intelligence but also in data processing, decision procedures, and in tactical and strategic war-gaming.

Single-Call-Sign Procedure: a Field Test

STUDIES at two exercises in the US showed that about one-third of radio transmission time was concerned with station identification and message handling. A promising way to reduce station identification time appeared to be through the use of the British single-call-sign procedure; on the basis of a word-count analysis, it offered a potential saving of about 30 percent.

Would this potential saving materialize in practice? To find out, ORO supervised a test in Korea, in March 1954, in which two US regiments used the procedure authorized by JANAP and one used the single-call-sign procedure.† *Finding:* At lower echelons and in vertical transmissions the British system does offer a considerable saving. But at higher echelons, since message length increases from echelon to echelon while identification time remains the same, the saving is only marginal.

Conclusion: The use of a single-call-sign procedure cannot be recommended on the basis of significant saving in time on the air. It may, though, offer an increase in security.

Meeting the Need for Linguists

HOW IMPORTANT has the language barrier been in the Far East, particularly in Korea? What can be done about it?

In getting answers to these questions, ORO has interviewed, in person or by questionnaire, some 1500 US and ROKA officers and men; studied the work of the Army Language School; set up an experimental school in basic Korean (on the Second Infantry Division Front in July 1953); and made other investigations.*

Main finding: The scarcity of military personnel able to speak either Korean or Chinese reduced the effectiveness of US Army forces in Korea and reduced US prestige. It was partly responsible for our problems in handling Communist POWs, seriously hampered military police operations, and interfered with the conduct of civil affairs.

Principal Recommendations

● Authorize the Army Language School (a) to begin courses in critical Asiatic languages that are not now taught and in which the Army has few or no competent linguists; (b) to offer extended training—18 months—to the top 25 percent in each graduating class in critical Asiatic languages (since in each of these languages

* ORO T-292 and ORO-T-308.

† ORO-T-57 (FEC).

* ORO T-63 (FEC).

the Army should train a few career officer-linguists to absolute fluency).

● Take an inventory of language and area knowledge in the Army. To facilitate this, supplement the Language Fluency Questionnaire with a self-evaluation-of-proficiency form like one presented in the study.

● Reassign to critical vacancies those scarce language specialists now occupying less critical positions in which their knowledge is not needed.

● Offer refresher courses in Korean and Chinese to linguists newly arrived in AFFE and those who have been there six months without having been called on to use their language.

● Give officers hereafter assigned as KMAG advisers a course in elementary Korean.

● Authorize the establishment of 40-hour courses in elementary Korean for all interested US troops in Korea. (Such courses are desirable from the standpoints of morale, increased troop efficiency, and improved US-Korean relations, and their cost probably would be nominal.)

● Consolidate duplicating Army, Navy, and Air Force language programs in critical languages at a national language academy, thereby conserving scarce language-teaching skills.

The Effect of Storms

A DETAILED study* of how three flood-producing rains affected the operations of the Eighth Army in Korea during the summer of 1953 leads to these main findings:

1. A rainfall of 3 to 4 inches in a period of 24 hours is generally sufficient to produce flood stages on the principal rivers in the Eighth Army area.

2. Weather forecasting in Korea is not sufficiently reliable to forecast such rainfalls 24 hours in advance.

3. Daily intelligence reports stated that the storms had no effect on ground operations. However, vital bridges were out, roads were closed, and airplanes were grounded.

4. Plans should be made for locating units such as storage depots in areas less subject to flooding, for designing bunkers and other earthworks to withstand and shed the water to be expected from summer rains, and for designing types of river crossings that can operate at flood stages. These plans should be based on a detailed study of the probability of rainstorms of certain intensities in Korea, and on the past history of flood heights and flooded areas.

5. More attention ought to be given to keeping a record of lessons learned during storm periods. Such a record could be of immense help during future operations.

* ORO T-58 (AFFE).

Major Subjects

on Which Work Is Under Way

TACTICS DIVISION

INFANTRY GROUP

1. Field test of squad radio.
2. Feasibility of large-scale, air-supported tactical operations.
3. Field test of salvo rifles.
4. Measures of rifle squad effectiveness.
5. Degradation of performance under combat stress.
6. Performance of combat riflemen, including evaluation of performance tests.

ARMOR GROUP

1. Relative tactical value of mobility, firepower, and armor.
2. Test design and instrumentation for armored field experiments.
3. Physical comparisons of tank types and equipments.
4. Logistics of armored warfare.
5. Feasibility of super-range logistics—free armored vehicles.

SUPPORT WEAPONS GROUP

1. Tactical vulnerability of CORPORAL and MATADOR guidance systems to electronic countermeasures.
2. Interdiction support of tactical ground operations.
3. Role of Army aviation in a future war.
4. Small-yield atomic weapons as a replacement for artillery concentrations.

5. Operational effectiveness of anticrop BW and CW.
6. Military effects of successful BW attacks on livestock.
7. Operational effectiveness of the CORPORAL missile with a GB warhead.

TACSPIEL GROUP

1. Battle simulation by high-speed computer techniques.
2. Quantification of the tactical effects of terrain and weather.
3. Determination and definition of measurable factors that serve as reliable battle-decision criteria.

LOGISTICS DIVISION

MOBILIZATION GROUP

1. Supply of sized clothing and footwear.

LINES OF COMMUNICATION GROUP

1. Dispersion of ships loading or unloading under threat of atomic attack.
2. Ship-to-shore transportation in the theater of operations.
3. US internal transportation system in event of war.
4. Analysis of the five-echelon maintenance system.
5. Policy guidance to US military government in occupied Germany.
6. Local civilian manpower utilization, Korea.
7. Survey of knowledge and opinions of US military government officers in World War II.
8. Treatment of politically undesirable elements: Denazification.

INTERDICTION GROUP

1. Combustion as a weapon for unconventional forces.
2. Compilation of data about unconventional warfare.

STRATEGIC DIVISION

OPSEARCH GROUP

1. Development of realistic economic models of enemy and Allied economies for application to strategic gaming.
2. Application of symbolic logic techniques to military problems.

3. Correlating computer and analytical solutions to tactical games.
4. Transient solutions to queuing problems.

COMPASS GROUP

An evaluation of ORO's contribution to psychological warfare research.

STRATSPIEL GROUP

Development and application of gaming techniques at the strategic level.

COMPLAB

Training programmers and coders for ERA 1103. Setting up Theater GEDA game.

ELECTRONICS LAB

Making gaming accessories for GEDA. Designing tank-vs-tank battle-effect simulators for maneuvers.

INTELLIGENCE DIVISION

ACQUISITION GROUP

1. Physical detectors and detector systems: (a) detection of targets by physical means; (b) detection accuracy; (c) planted and delivered detectors.
2. Limitations of terrain on line-of-sight surveillance and communications.
3. Duration of targets.
4. Probable targets from minimum intelligence information.

COMMUNICATIONS GROUP

1. Information flow processes in the communication of battlefield intelligence.
2. Automatic display methods for combat information.

DECISION PROCEDURES GROUP

1. The decision and evaluation process as it relates to tactical action.
2. Evaluation of inteiligence information.

HOME DEFENSE DIVISION

WEAPONS GROUP

1. Warning and control requirements for air defenses.
2. Requirements for control and coordination of local defense weapons.
3. The effectiveness of NIKE, TALOS, HAWK, PORCUPINE, and interceptors.
4. Requirements for nuclear warheads for surface-to-air missiles.
5. Evaluating BOMARC, LOKI, and TERRIER.
6. Defense against intercontinental ballistic missiles.

TARGETS GROUP

1. Thermonuclear weapons effects on US metropolitan areas.
2. Relative values of US targets in terms of war potential.
3. The optimum distribution of active ZI defenses.
4. The effects on US war potential of varying amounts of damage to the economy.
5. Passive defense measures for isolated facilities.
6. Effectiveness of evacuation and other measures for reducing the vulnerability of civilian populations.
7. Cost-effectiveness of passive measures in the over-all defense system.
8. Vulnerability of the US to BW and CW munitions.
9. Psychological and morale effects of air attacks on the US.
10. Vulnerability of the US and its defense system to sabotage.
11. Vulnerability of US targets to the fallout of thermonuclear weapons.

Note that findings of most of the studies listed for the Home Defense Division are being covered in a comprehensive summary report.

FIELD DIVISION

ORO-USAREUR

1. Technical means for reinforcing the natural barrier characteristics of a major river line.
2. Restrictions imposed by mass German refugee movement on the tactical freedom to employ special weapons.

3. Comparative analysis of the 280–mm gun and the 762–mm rocket.
4. Technical means for detecting enemy movement.
5. Atomic demolitions.
6. The requirements for and the feasibility of an air defense system for Western Europe.

ORO-USAFFE

1. The tactical employment of atomic weapons in the Far East.
2. The need for revisions in Army logistic doctrine, as determined by Korean war experience.

ORO-OCAFF

1. Field tests to determine the impact of atomic weapons upon tactics. Includes studies on the vulnerability of infantry and artillery units to atomic weapons and on instrumentation for control and data collection in field maneuvers.
2. Development and application of war-gaming methods to specific tactical problems. Includes such studies as (a) methodology, criteria, and experience factors in war-gaming; (b) the war-gaming of two-sided, small-unit combat, in collaboration with Tactics Division.

SPECIAL STAFF SECTION BRAND

1. Recommendations for Army R&D Program.
2. How best to present status reports on Army programs to top management.
3. Evaluation of Army weapons inventories.
4. Relation of procurement schedules to inventories and to obsolescence.

PSYCHOLOGICAL WARFARE STUDIES

1. A case book in psychological warfare.
2. Czechoslovakia: An area manual.
3. Czechoslovakia: A handbook for psywar personnel.
4. Leaflet dissemination for psychological warfare.
5. Critical requirements for psywar personnel.

3. Comparative analysis of the 280—mm gun and the 762—mm rocket.
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ORO PUBLICATIONS

1 July to 31 December 1954

REPORTS

ORO Number	Classification	Group	Title
R-1 (EUCOM) Summary Report	TOP SECRET RESTRICTED DATA SPECIAL HANDLING	INFANTRY (Tactics)	The Tactical Employment of Atomic Weapons in the Defense of Central Europe
Appendix K	TOP SECRET RESTRICTED DATA SPECIAL HANDLING	INFANTRY (Tactics)	An Analysis of the Proper Balance of Special Weapons Forces, Central Europe, FY 56
R-10 Vol V	TOP SECRET SPECIAL HANDLING REGISTERED	WEAPONS (Home Defense)	CNCSOIYADPNATTSS
R-12 Vol I	TOP SECRET SPECIAL HANDLING REGISTERED	WEAPONS (Home Defense)	WNENCSOIYADPNATTSS
R-12 Vol II	TOP SECRET SPECIAL HANDLING REGISTERED	WEAPONS (Home Defense)	ASOWNENSCOIYADPNATTSS
R-15 Vol I	SECRET RESTRICTED DATA SPECIAL HANDLING	POWER (Research Study)	Nuclear Reactor Power Plants for Aircraft Control and Warning Station in the Artic

TECHNICAL MEMORANDA

ORO Number	Classification	Group	Title
T-259	UNCLASSIFIED	INFANTRY (Tactics)	Human Factors in Military Operations—Some Applications of the Social Sciences to Operations Research
T-260	UNCLASSIFIED	INFANTRY (Tactics)	Improving the Combat Effectiveness of Riflemen—An Operational Evaluation of Measures of Combat Effectiveness for Field Use
T-263	UNCLASSIFIED	OPSEARCH (Strategic)	Generalized Battle Games on a Digital Computer
T-266	CONFIDENTIAL	INFANTRY (Tactics)	Problems of Field Tactics in Defense against Area Weapons
T-268	CONFIDENTIAL	INTERDICTION (Logistics)	Japanese Operations against Guerrilla Forces
T-269	SECRET SPECIAL HANDLING	INTERDICTION (Logistics)	Allied Supplies for Italian Partisans during World War II
T-277	UNCLASSIFIED	INFANTRY (Tactics)	Radio within the Infantry Battalion in the Jungle
T-280	SECRET	LOC (Logistics)	The Validity of Strategic Logistic Planing Factors as Estimators of Logistic Requirements
T-285	CONFIDENTIAL	LOC (Logistics)	Army Payments in Korea—An Inquiry into the Financing of Military Procurement
T-288	SECRET RESTRICTED DATA	WEAPONS (Home Defense)	Underwater Pressure Field from Shallow A-Bomb Bursts
T-289	CONFIDENTIAL	INFANTRY (Tactics)	Casualties as a Measure of the Loss of Combat Effectiveness of an Infantry Battalion
T-291	SECRET RESTRICTED DATA	INFANTRY (Tactics)	Army Officers' Knowledge of Atomic Weapons, Their Effects and Uses

ORO Number	Classification	Group	Title
T-292	UNCLASSIFIED	OPSEARCH (Strategic)	Digital Simulation and [illegible] rational Methods for Some Aspects of the Functional [illegible] of Symbolic Logic
T-297	CONFIDENTIAL	INTERDICTION (Logistics)	[illegible]ilitary Potential of Combat Units Isolated in Enemy Rear Areas
T-315 Vol I	SECRET	(Home Defense)	Wartime Production Potentials by Areas and Economic Activity Type Text and Summary Tables
T-315 Vol II	SECRET	(Home Defense)	Wartime Production Potentials by Areas and Economic Activity - Manufacturing War Industries
T-315 Vol III	SECRET	(Home Defense)	Wartime Production Potentials by Areas and Economic Activity - Manufacturing War Industries
T-315 Vol IV	SECRET	(Home Defense)	Wartime Production Potentials by Areas and Economic Activity - Manufacturing Industries
T-42 (FEC)	CONFIDENTIAL	POWOW	A Study of North Korean and Chinese Communist Attitudes toward Communist China and the United States
T-9 (USAREUR)	SECRET SPECIAL HANDLING	Project 3 (USAREUR)	[illegible] Use of Communications to Control Movements
T-10 (USAREUR)	TOP SECRET RESTRICTED DATA SPECIAL HANDLING	INFANTRY (Tactics)	[illegible]
T-11 (USAREUR)	SECRET RESTRICTED DATA SPECIAL HANDLING	INFANTRY (Tactics)	[illegible]